Beryllium

Control Program

Implementation of DOE N440.1
Interim Chronic Beryllium Disease Prevention Program

Table of Contents

Acronyms

ACGIH	American Conference of Governmental Industrial Hygienists
Be	Beryllium
BeO	Beryllium Oxide
BRAC	Beryllium rulemaking Advisory Committee
CBD	Chronic Beryllium Disease
CBDPP	Chronic Beryllium Disease Prevention Program
CHEMTRACK	Chemical Tracking Database
ES&H	Environment, Safety, and Health
FSP	Facility Safety Procedure
H & S	Health and Safety
HAC	Hazard Assessment and Control Form
HC	Hazards Control
HEPA	High Efficiency Particulate Air
ICP	Inductively Coupled Plasma Emission Spectroscopy
IH DAP	Industrial Hygiene Discipline Action Plan
IHPIM	Industrial Hygiene Policy and Information Manual
LPT	Lymphocyte Proliferation Test
LROCC	Laboratory Repository of Completed Courses
LTRAIN	Livermore Training Records and Information Network
MSWG	Medical Surveillance Working Group
NEA	Negative Exposure Assessment
NIOSH	National Institute for Occupational Safety and Health
ORISE	Oak Ridge Institute for Science and Education
OSHA	Occupational Safety and Health Administration
OSR	Operational Safety Requirement
PEL	Permissible Exposure Limit
STAR	Sample Tracking and Reporting Database
STEL	Short Term Exposure Limit
TLV®	Threshold Limit Value
TSR	Technical Safety Requirement
TWA	Time Weighted Average

Lawrence Livermore National Laboratory

Beryllium Control Program

Introduction

Beryllium has been recognized as a significant health hazard throughout the history of the Lawrence Livermore National Laboratory. Specific controls were enumerated in the Berkeley and Livermore *Accident Prevention Manual* signed by Ernest O. Lawrence (1960) and amplified later in the Lawrence Radiation Laboratory Hazards Control Manual (1963). The Department of Energy (DOE) has recognized the significant potential risk to persons working with beryllium in publishing DOE Notice 440.1, "Interim Chronic Beryllium Disease Prevention Program (CBDPP)" and DOE G 440.1-7, "Draft Implementation Guide for use with DOE Notice 440.1 Interim Chronic Beryllium Disease Prevention Program." The DOE has also initiated an accelerated rulemaking process for beryllium.[1,2,3]

Presently, there are no known cases of chronic beryllium disease due to work at LLNL.[4] Personal exposure measurements, although limited in number, have not shown beryllium exposures in excess of the OSHA permissible exposure limit of 2 $\mu g/m^3$. The area samples, while not a good indicator of personal exposure, are overwhelming <0.2 $\mu g/m^3$. This is due largely to the requirement that beryllium operations that have the potential for producing dust have been done in engineered enclosures. For these reasons beryllium operations at LLNL are believed to present low risk to the worker.

The intent of this document, "Beryllium Control Program," is to describe the program already in place at LLNL to control exposures to beryllium and to identify differences between it and the requirements of DOE N440.1. It is important to note, that while there are program elements specific to beryllium, the program as a whole is integrated into the industrial hygiene program at LLNL. Where the LLNL program differs from DOE

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[1] Federal Register, May 23, 1997, 62 FR 28455

[2] Federal Register, September 5, 1997, 62 FR 46954

[3] Federal Register, September 10, 1997, 62 FR 48651

[4] There have three cases of *possible* beryllium disease, but no incidence in the population in the medical surveillance program since 1967:

(i) 1958. Machinist with skin granulomas on forearms. No record of lung disease.

(ii) 1958. Technician with acute pneumonitis at Site 300; workers compensation given for beryllium related disease. Worker recovered with normal x-rays, outcome casts doubt on beryllium as cause.

(iii) 1967. Worker with pulmonary fibrosis. Brief exposure only. Workers compensation accepted. Diagnosis of beryllium disease doubted by UCSF consultant based on post mortem examination.

N440.1 and changes have been or are to be made, the actions completed, in progress, or planned are noted with estimates of completion dates.

Differences between the LLNL program and DOE N440.1 are in the following areas:

1. The baseline inventory of beryllium work currently identifies all locations of higher hazard operations, but only some locations for lower hazard operations. (DOE N440.1, Attachment 1, paragraph 1).

2. Hazard Assessments exist in a variety of formats for higher hazard operations, but have been done for only some lower hazard operations. (DOE N440.1, Attachment 1, paragraph 2).

3. Personal monitoring has primarily on those operations considered high risk, historical monitoring data is primarily area sampling rather than personal monitoring. (DOE N440.1, Attachment 1, paragraph 3).

4. Exposure goals and guidance for minimizing beryllium exposure exists in the current LLNL program, however, the program does not reflect current DOE policy. (DOE N440.1, Attachment 1, paragraph 4).

5. The medical surveillance program does not identify all employees who are currently exposed or who may have been exposed in the past (only those workers at higher relative risk have been identified), nor does the program currently offer beryllium-specific medical tests to affected employees. (DOE N440.1, Attachment 1, paragraph 5).

6. Although a beryllium hazard training program does exist that meets OSHA hazard communication training requirements, the program does not present risks associated with beryllium exposure commensurate with DOE N440.1. (DOE N440.1, Attachment 1, paragraph 6).

These changes will be made according to the schedule noted in discussion of implementation of DOE N440.1 that follows.

At LLNL beryllium metal, alloys, ceramic, and compounds are used in a variety of areas. Operations include LLNL/DOE activities as well as work with the private sector:

beryllium mirror technology
development of laser cutting technology
development of laser welding technology
electron beam welding of parts
facility and equipment maintenance
laser annealing of plasma sprayed beryllium

sputtering and coating of parts
weapons programmatic uses

Disease due to beryllium exposure may be manifested in a number of ways[5], the most significant of which are

- acute beryllium disease: short duration disease due to elevated exposure to soluble compounds such as BeF_2 or $BeCl_2$
- chronic beryllium disease (CBD): long duration disease due to exposure to insoluble beryllium compounds for which there is no cure
- lung cancer: disease observed in animal studies believed relevant to human exposure

A small percentage, 1-3%, of the general population is subject to developing a beryllium sensitization upon exposure[6]. Of these a portion will eventually go on to develop chronic beryllium disease after a latency period of 1-40 years.

There is considerable disagreement as to whether or not the current OSHA permissible exposure limit or the ACGIH TLV® is sufficiently protective, indeed even if there is a safe exposure level. There is also conflicting evidence as to whether or not there is a dose-response relationship.[7, 8]

Policy

The LLNL policy for the control of personal and environmental exposure to beryllium is established in Health and Safety Manual Supplement 21.10, "Safe Handling of Beryllium and Its Compounds," dated December 1991, is:

> "...to eliminate unnecessary Be exposure and reduce exposure to levels well below Occupational Safety and Health Administration (OSHA) regulations."

Other Health and Safety Manual requirements relevant to the control of beryllium are given in the following sections of the manual:

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[5] M. D. Rossman, O. P. Preuss, M. B. Powers, eds., *Beryllium: Biomedical and Environmental Aspects*, Williams & Wilkins, Baltimore, 1991.

[6] Agency for Toxic Substances and Disease Registry, *Case Studies in Environmental Medicine: Beryllium*, US Department of Health and Human Services (Public Health Service), 1992.

[7] US DOE, "Draft Implementation Guide for use with DOE N440.1," 7/11/97 draft, and references cited therein.

[8] Marc E. Kolanz, "Comments of Brush Wellman, Inc., on the Department of Energy's Notice Requesting Information Relative to Control of Occupational Exposure to Beryllium in DOE Facilities," March 13, 1997.

Chapter 1. LLNL ES&H Polices and Responsibilities
Chapter 2. Integrating ES&H into Laboratory activities
-Supplement 2.02. Preparation of Operational Safety Procedures and Facility Safety Procedures
-Supplement 2.30. Guidelines for the Decontamination and Disposition of Process contaminated Facilities and Associated Equipment
Chapter 5. Medical Program
Chapter 6. Design and Construction
-Supplement 6.06. Safety Analysis Guide
Chapter 7. Environment, Safety and Health Education
-Supplement 7.02. Health Hazard Communication
Chapter 8. Hazardous Material Control
-Supplement 8.07. ES&H Requirements for Equipment Repair, Transfer, Storage and Excess
Chapter 10. Personal Protective Equipment
Chapter 12. Ventilation
-Supplement 12.01. Evaluation and Control of Facility Airborne Effluents
-Supplement 12.03. Work Enclosures for Toxic and Radioactive Equipment
-Supplement 12.05. High-Efficiency Particulate Air (HEPA) Filter system Design Guidelines for LLNL Applications
Chapter 21. Chemicals
-Supplement 21.10. Chemical Hygiene Plan for Laboratories
-Supplement 21.16A. Safe Handling of Chemical Carcinogens in Research Laboratories
-Supplement 21.16B. Safe Handling of Chemical Carcinogens in General Work Areas

Procedures and methodology for the industrial hygiene field staff are documented in the LLNL Industrial Hygiene Policy and Information Manual. Relevant sections are:

IHPIM #50 Exposure Assessment and Monitoring Plan
IHPIM #52 Personal Monitoring Reports
IHPIM #71 The Industrial Hygiene Discipline Action Plan
IHPIM #87 Appendix C: Negative Exposure Assessments
IHPIM #150 Respiratory Protection: General Policy
IHPIM #152 Issuance and Return of Respirators
IHPIM #153 Respirator Selection Policy
IHPIM #155 Respirator Training Requirements
IHPIM #156 Respirator Fit Testing

Specific actions required by the ES&H Team Health and Safety Technicians supporting beryllium work are documented in the Industrial Hygiene Discipline Actions Plans. Relevant sections are:

IH-01 IH Problem Areas - Hazardous Areas
IH-03 IH Work Practices
IH-04 Eyewashes and Emergency Showers
IH-05 HEPA Filter Surveillance Program - DOP Test
IH-06 HEPA Filter Surveillance Program - Inspection
IH-07 HEPA Filter Surveillance Program - Non-routine
IH-08 Spill Cleanup
IH-11 Respiratory Protection
IH-14 Beryllium Monitoring
IH-20 Exhaust Ventilation - Velocity Measurements
IH-21 Exhaust Ventilation - Operation Tests
IH-25 Toxic Material Vacuums

Control Program Elements

DOE Notice N440.1, "Interim Chronic Beryllium Disease Prevention Program," provided in Appendix A, established eight elements for the control of beryllium:

1. Baseline Inventory and Sampling.
2. Hazard Assessment.
3. Exposure Monitoring.
4. Exposure Reduction and Minimization.
5. Medical Surveillance.
6. Training.
7. Recordkeeping.
8. Performance Feedback.

At LLNL these are implemented as follows:

1. Baseline Inventory and Sampling.

The Health and Safety Manual, and its Supplements, is the Laboratory's policy for all aspects of safety and health. All lower tier safety documents are derived from it.

The Facility Safety Procedure (FSP) is the umbrella safety document for a facility that defines permitted activities and required levels of control. The FSP implements specific requirements of the Health and Safety Manual. The document also defines operations within the scope of the FSP, but are permitted only with prior review, or that require an Operational Safety Procedure (OSP) prior to start-up. Beryllium operations are required

by H&S Manual Supplement 21.10, "Safe Handling of Beryllium and Its Compounds" to have an OSP if there is a potential for generating a beryllium aerosol (dust, fume, or mist). For an FSP to substitute for an OSP specific controls must be written into the FSP. Supplement 21.10 is provided as Appendix B.

The guidelines for preparing FSPs and OSPs address each of the following topics (see Health and Safety Manual Supplement 2.02 for details):

FSP Topics

1. Introduction
2. Responsibilities and Authorities
3. General Building Policies and Controls including TSRs and OSRs
4. Operations: ES&H Hazards Analysis and Control Integration
    - 4.1 Normal Operations and Controls
    - 4.2 Authorized Operations and Controls
    - 4.3 Operations Requiring Prior Review
    - 4.4 Operations Requiring a Supplemental OSP
5. Training Requirements
6. Maintenance, Inspection, and Quality Assurance of Safety Systems, Environmental Systems, and Equipment
7. Emergency Response Plan and Procedures
8. References

Appendices

- A. Building floor plans
- B. List of organizations operating in the facility
- C. Emergency call-out list
- D. Emergency response procedures
- E. Self-help plan
- F. Spill contingency plan
- G. Required reading list
- H. Other

OSP Topics

1. Reason for Issue
2. Work to be Done and Location of Activity
3. Responsibilities
4. Operations: Hazards Analysis and ES&H Controls Integration
5. Training and Required Reading
6. Maintenance, Inspections, and Quality Assurance
7. Emergency Response Plans and Procedures
8. References
9. Review and Approval
10. Safety Review by all persons covered by the OSP

The FSPs and OSPs are written by the programs and are reviewed by program management and appropriate disciplines, including Industrial Hygiene, from the ES&H Teams. The FSPs are approved by the Facility Associate Director for the program, OSPs are approved by designated program managers.

The Industrial Hygiene Discipline Action Plan (IH DAP) identifies industrial hygiene health and safety services provided by the ES&H Team to the program or facility. IH DAP Instructions #IH-01 (IH Problem Identification-Hazardous Areas) and #IH-14 (Beryllium Monitoring), also identify areas where beryllium is handled. IH-01 is provided as Appendix C; IH-14 is provided as Appendix D.

IH DAP #14 currently stratifies beryllium work areas for periodic monitoring according to the following scheme based on exposure measurements:

Table 1. Periodic Monitoring Frequency

Exposure Level	Personal Samples	Area Samples	Swipe Samples
High: $\geq$ 2 µg / m^3	daily of all workers	weekly, locations specified by IH	weekly, locations specified by IH
Moderate: ≥ 0.2 µg / m^3, but < 2 µg / m^3	at least annually, or at frequency determined by IH	periodic as determined by IH	periodic as determined by IH
Low: < 0.2 µg / m^3	at the request of IH	at the request of IH	at the request of IH

The LLNL chemical inventory system, CHEMTRACK, is available to search for all locations where beryllium or any of its compounds are stored. These items are inventoried and barcoded as they are received at LLNL; when the user has consumed the material, the barcode is returned to CHEMTRACK and the material is taken off the inventory. CHEMTRACK does not track material that falls under the OSHA definition of an "article" (such as beryllium windows present in x-ray machines; see 29 CFR 1910.1200) nor does it track prior uses of a material.

Actions in Progress and Estimated Date for Completion

Locations where beryllium work is currently performed are being tabulated by a review of existing safety documentation: FSPs, OSPs, and Hazard Assessments. (Estimate 1/98)

CHEMTRACK inventory of beryllium storage and use areas has been requested. (Complete 11/18/97)

Proposed Actions

(1) Assimilate corporate knowledge of the industrial hygiene staff. (Estimate 4/98)

(2) Those areas or operations for which baseline sampling does not exist will be grouped with Hazard Assessment and Exposure Monitoring, below, for sampling. (Estimate 12/98)

(3) Interview relevant program management and workers with a significant longevity at LLNL to ascertain historical Be work areas. (Estimate 4/98)

2. Hazard Assessment
and

3. Exposure Monitoring

Hazard Assessment and Exposure Monitoring at the worker level are addressed jointly by the industrial hygiene program. The policy and methodology for Hazard Assessment and for Exposure Monitoring is documented in IHPIM #50, "Exposure Assessment and Monitoring Plan." This document assigns responsibilities to divisions within Hazards Control (ES&H Field Teams, Technical Support & Policy Development Division, Safety Labs Division, and Management Information Systems Team) as well as to Health Services. IHPIM #50 is provided as Appendix E.

Hazard Assessment and Control Form

The primary tool for hazard assessment is the Hazards Assessment and Control or HAC form. The HAC includes the following data:

operation location
responsible individual
responsible ES&H Team
references to pertinent operation or facility safety procedures
operation description
frequency and duration of operation
identification of personnel performing the operation, their job code, and their relative exposure potential
identification of hazards (chemical, biological, radiological, and physical agents)
qualitative exposure assessment for all hazards
determination of the need for further quantitative evaluation (i. e., monitoring)
determination of the need for medical surveillance
determination of the need for engineering controls
determination of the need for administrative controls (i. e., training)
determination of the need for personal protective equipment (with specific PPE identified if needed)

If the operation is on-going, then the need for periodic monitoring (personal air sampling, area air sampling, and/or swipe sampling) will be identified in the IH Discipline Action Plan, element #IH-14, "Beryllium Monitoring."

The cognizant industrial hygienist has the option of conducting personal air sampling, area air sampling, and/or swipe sampling that will best suit to evaluate personal exposures, the potential for exposures, or the effectiveness of controls. Sampling is done in accordance with NIOSH and OSHA sampling methodology.

The policy and methodology for producing a Negative Exposure Assessment (NEA) is established in Appendix C of IHPIM #87. The process was developed for asbestos and lead exposure, but may be used for any hazardous material. An NEA documents that controls and work practices are sufficient to prevent hazardous exposures thus permitting relief from certain regulatory requirements. Although there are presently no regulatory requirements for beryllium (other than the OSHA PEL) the process can be used to document adequate control for a process.

Sample Analysis

Analysis of air and swipe samples is done by a modification of NIOSH Method #7300 for beryllium metal or by an LLNL developed procedure for high fired beryllium oxide using inductively coupled plasma (ICP) atomic emission spectroscopy. The modified NIOSH procedure for beryllium metal uses nitric acid only as the ashing agent rather than the nitric/perchloric acid mixture recommended by NIOSH #7300. The high fired

beryllium oxide requires the use of a nitric/sulfuric acid mixture to effect complete dissolution.[9]

For air samples where analysis of only one metal is needed samples are dissolved to make 10 ml of solution; for air samples where more than one metal is to be analyzed samples are dissolved to make 25 ml of solution. Swipes samples are dissolved to make 25 ml of solution. The respective ICP detection limits are 0.008 µg/10 ml (0.0008 µg/ml) for single metal air samples, and 0.02 µg/25 ml (0.0008 µg/ml) for multiple metals or swipe samples.

Air samples are typically taken with a personal sampling pump operating at 2 liters/minute, sample times vary from 15 minutes to full shift (nominally 8 hours). Swipes are typically taken dry over a 100 cm^2 area. Depending on the specific instance other flow rates or sample sizes are used. Table 2, below, gives representative detection levels for air and swipe samples for short term, typical job length, and normal swipe area samples.

Measured airborne exposures will be documented in memoranda to the affected workers, their supervisors, appropriate program management, and Health Services. Guidelines for reporting exposure results are provided in IHPIM #52, "Personal Monitoring Reports."

Table 2. Detection levels for beryllium samples

Sample Type	Sample size	Concentration
short term air sample	15 min @ 2 l/min	0.27 µg/m^3 (STEL)
long term air sample, Be only	120 min @ 2 l/min	0.008 µg/m^3 (TWA)
long term air sample, Be and other metals	120 min @ 2 l/min	0.02µg/m^3 (TWA)
normal swipe sample	100 cm^2	0.0002 µg/cm^2

[9] Copies of the modified NIOSH analytical procedure, the high fired BeO procedure, and quality control documentation are available at the Hazards Control Analytical Laboratory.

Actions in Progress

The ES&H Team Industrial Hygienists are in the process of writing Hazard Assessments for all current beryllium operations.

Operations will be prioritized for personal sampling if they are not already characterized.

Estimated date for completion
Hazard Assessment: (4/98)
Sampling: (12/98)

4. Exposure Reduction and Minimization.

Health and Safety Manual Supplement 21.10, "Safe Handling of Beryllium and Its Compounds," dated December 1991, is the current program for controlling beryllium at LLNL. The exposure goal, as noted above in "Policy," is to maintain exposures well below the OSHA standard of 2 $\mu g/m^3$. The analytical services available at LLNL permit exposure measurements to levels substantially below this level, and below the administrative level of 0.2 $\mu g/m^3$ established in Supplement 21.10.

The supplement establishes Engineering Controls, Personnel Controls, and Administrative Controls. The essential elements of the program are:

Engineering Control

- processes that produce dust shall be done wet when possible, and in a ventilated enclosure
- exhaust from ventilated enclosures shall be exhausted to the environment through HEPA filters
- ventilation shall be tested annually and operationally evaluated quarterly
- Be-contaminated parts and equipment shall be contained
- entire laboratories or shops designated as beryllium work area shall be maintained at negative pressure with respect to surrounding areas
- Be ventilation systems shall meet applicable permitting requirements

Personnel Control

- protective clothing (coveralls, lab coats, gloves, respirators) shall be specified by the ES&H Team supporting the activity
- workers shall wash after performing beryllium operations
- spills shall be promptly cleaned up

Administrative Control

- all beryllium work capable of generating fine particulate shall be covered in an Operational Safety Procedure (OSP); an FSP may be used when controls are specifically addressed
- all workers working with beryllium shall be trained in the hazards of beryllium and controls necessary to minimize exposure (see Section 6, below)
- acceptable concentrations for airborne exposure and surface contamination have been established
- monitoring plan shall be established (see industrial hygiene discipline action plan element IH-14, Appendix D, for specifics)
- persons with a potential for beryllium exposure shall be identified to Health Services for inclusion in the beryllium medical surveillance program
- decontamination of beryllium work areas shall be performed regularly
- equipment to be serviced, excessed, or disposed off shall be surveyed for beryllium contamination; contamination levels will be documented
- beryllium work areas and equipment used for beryllium work shall be posted or labeled to indicate the presence of beryllium (see Figures 1 and 2)

LLNL adopted, in Health and Safety Manual Supplement 21.10 (consistent with DOE policy established in DOE Order 5480.4) the OSHA permissible exposure limit (PEL) and ACGIH Threshold Limit Value (TLV®) of 2 $\mu g/m^3$ as an 8-hour time weighted average for beryllium. The basis for the TLV is published by the ACGIH.[10, 11] A ten-fold safety margin is assumed in establishing the administrative action level of 0.2 $\mu g/m^3$. These two levels then establish points at which specific actions are to be taken to maintain beryllium exposure at acceptable levels. These, with required actions, are given in Table 3.

At analytical sensitivity of the method for beryllium air samples permits short term exposures to be measured at levels significantly less than the ACGIH Short Term Exposure Limit (STEL) of 10 $\mu g/m^3$, see Table 2.

LLNL has established acceptable levels of surface contamination for areas considered "clean," and for areas where beryllium work is done. These levels are based on (1) dry swipes and (2) analytical level of detection at the time they were established. The surface contamination levels must be considered as guidelines only as the technique is considered qualitative only. There is no definitive relationship between surface contamination and airborne exposure levels; nonetheless, they may be used as an indicator

[10] *Documentation of the Threshold Limit Values and Biological Exposure Indices*, Sixth Edition American Conference of Governmental Industrial Hygienists, Cincinnati, 1991.

[11] *Threshold Limit Values for Chemical Substances and Physical Agents, Biological Exposure Indices*, American Conference of Governmental Industrial Hygienists, Cincinnati, 1997,

of housekeeping. See K. J. Kaplan, "The Significance of Wipe Samples."[12] Table 3 gives the respective limits and actions to be taken if beryllium surface contamination exceeds the indicated levels.

Table 3. Maximum administrative permissible levels for Be-processing areas

Type	Level	Condition	Action required
Air (8-hr average)	<0.2 µg / m^3	normal	none
	0.2-2.0 µg / m^3	warning	investigate cause and correct
	>2.0 µg / m^3	limit exceeded	stop work, investigate cause, and correct

Table 3. (continued)

Type	Level	Condition	Action required
Air (15 min STEL)	>10 µg / m3	limit exceeded	stop work, investigate cause, and correct
Surface contamination	<0.01 µg / cm^2	clean	none
Surface contamination (continued)	0.01-0.03 µg / cm^2	permissible	only for designated Be-processing are
	0.03-2.0 µg / cm^2	warning	decontaminate, investigate, and correct
	>2 µg / cm^2	limit exceeded	stop work, decontaminate, investigate, and correct

The LLNL Health Hazard Communication Program has a adopted a generic posting to notify workers of potential chemical and physical hazards in the workplace. See Section 6, Training, below, and Health and Safety Manual Supplement 7.02, LLNL Health Hazard Communication Program. In addition, Health and Safety Manual Supplement 21.10

[12] K. J. Kaplan, "The Significance of Wipe Samples," Am. Ind. Hyg. Assoc. J., 54:70-75; 1993.

requires beryllium work areas, storage areas, or equipment with a potential for producing a beryllium aerosol to be posted with a danger warning sign, Figure 1. Containers (shipping, storage, packaging) of beryllium or compounds with a potential for producing a beryllium aerosol are required to labeled with a danger label, Figure 2.

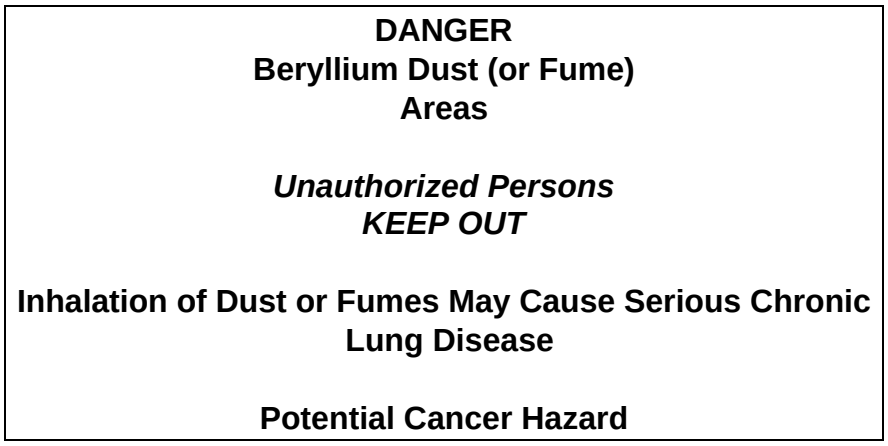

Figure 1. This warning sign shall be affixed in a readily visible location on equipment, storage areas, or areas where exposure to beryllium dust or fume is possible

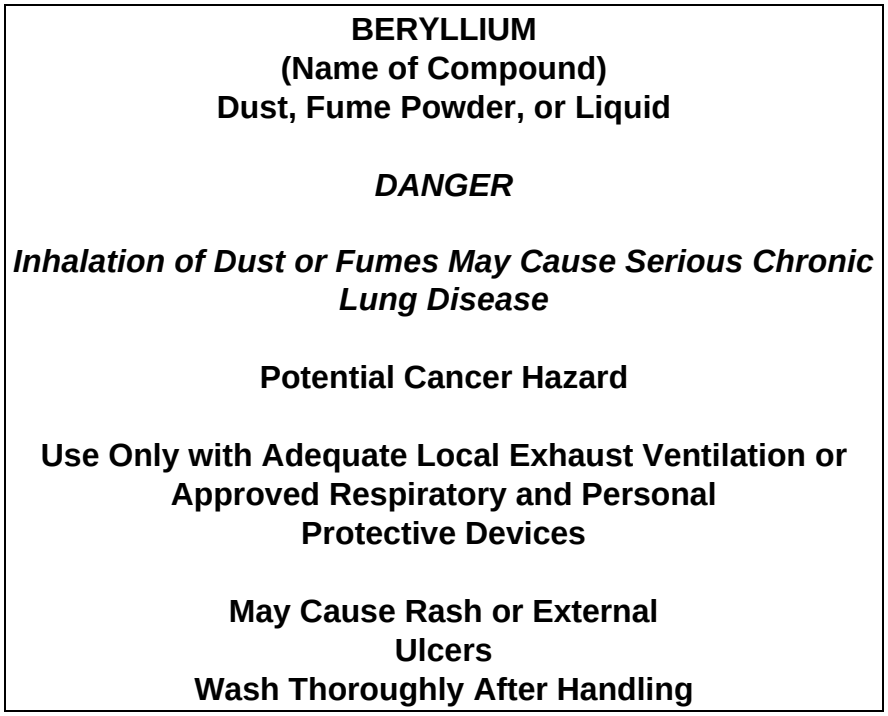

Figure 2. This warning label shall be affixed to all shipping, storage containers, or packages containing beryllium compounds

The DOE Beryllium Rulemaking Advisory Committee (BRAC) in its summary report identified five global areas of concern:[13]

Behavioral / Psychological Communications Issues
Identification of Workplace Hazards
Health Matters
Managing Workplace Risks
Economic Issues

The issues identified in each of these categories will be used to formulate the draft beryllium rule. The proposed rule is expected to be published in the Federal Register in late Spring 1998, with a period for public comment. Revision of Health and Safety Manual Supplement 21.10 should follow the rule as it is published; a revision of the Supplement earlier would not be a good use of LLNL resources.

Actions in Progress

Revision of Health and Safety Manual Supplement 21.10 has been assigned to the LLNL Hazards Control Department.

Estimated date for completion
Completion date is dependent on approval of this implementation plan by DOE / DP-1. (Estimate 12 / 98)

5. Medical Surveillance.

The LLNL Medical Surveillance Program is established in Health and Safety Manual Chapter 5, "Medical Program," and Health Services implementing documents. Specific requirements for the beryllium medical surveillance program are identified in Health and Safety Manual Supplement 21.10. The medical protocol and supporting information are provided in Appendix G. The supervisors are required to identify to Health Services annually those workers with a potential for exposure to beryllium, with guidance provided by the industrial hygiene staff.

[13] Letter from C. Rick Jones, DOE Beryllium Rule Advisory Committee to George W. Campbell, November 14, 1997.

The Medical Surveillance Working Group (MSWG) has been established with representatives of appropriate individuals from the Health Services Department and Hazards Control to determine appropriate protocols for medical surveillance issues.

Workers identified as potentially exposed to beryllium will be prioritized for medical surveillance according to the Table 4:

Table 4. Priority for Medical Surveillance

Priority Group	Description	Examples
1	(1) works with beryllium regardless of level of airborne exposure, or (2) any worker with documented exposure greater than the administrative action level	machinist, mechanical technician, hazardous waste handler, janitor
2	Any worker required to be in a beryllium work area regardless of level	shop supervisor, project engineer (no hands-on

Table 4. (continued)

Priority Group	Description	Examples
	of airborne exposure, but does not work directly with beryllium	exposure), Health & Safety Technician
3	Any worker transient in a beryllium work area, but does not work directly with beryllium	Visitor, delivery person, inspector, ES&H Team safety discipline

The prioritization scheme divides workers into three categories based on their contact with beryllium and the potential for being exposed to a beryllium aerosol. When a category of worker is noted in the above examples, only those workers with a potential for exposure are included in the priority group.

Health Service maintains the roster of all workers identified for the medical surveillance program. The roster will include those employees currently working with beryllium or working in beryllium areas, as well as those workers who no longer work with beryllium in their current assignments but did so in the past. Those workers no

longer exposed will be prioritized as persons identified in Priority Group 1 and will be scheduled with Group 1; the decision of whether or not to offer medical surveillance to Priority Groups 2 and 3 will be made on the basis of the outcome of Priority Group 1, i. e., if evidence of sensitization or disease is seen in Group 1, then Group 2 will be scheduled for medical surveillance.

Actions Completed

Pull charts and collect work history survey forms**.** (Complete 9/97)

First draft of medical surveillance protocol. (Complete 11/97)

Finalize arrangements for clinical follow up with Dr. Newman (National Jewish Hospital) (11/97: K. Noonan)

Review training records to identify workers potentially at risk. (Complete 12/97)

Actions Completed (continued)

Define exposure risk matrix categories (12/97: G. Fulton)
- Establish for workers in Priority Groups 1, 2, and 3.

Actions in Process

Exposure characterization (4/98: HC Team IHs)

Update Medical Surveillance list (ongoing; estimate complete 4/98)

Send out Be work exposure survey to employees on list not on active surveillance and other concerned employees (4/98: MSWG)

Review completed survey forms regarding work history (Estimate 7/98: Team IHs, MSWG)

Finish draft medical surveillance protocol document (1/98: S. Burastero)

Stratify comprehensive list of current LLNL employees into 3 exposure categories (on going: MSWG)

Perform LPT on Priority Group 1 current Be workers (Estimate Spring-Fall '98: HSD)
- Medical work up on positives, if any (National Jewish Hospital)

Analyze results of testing on Priority Group 1
- Determine prevalence of LPT positives (Estimate Winter '98)

LPT on Priority Groups 2 and 3 if results indicate (1999, if warranted by Priority Group 1 results)

6. Training.

The Laboratory policy for training is established in the LLNL *Training Program Manual*, implemented by Health and Safety Manual Chapter 7, "Environment, Safety, and Health Education," and Health and Safety Manual Supplement 7.02, "Health Hazard Communication." Specific beryllium training requirements are enumerated in Health and Safety Manual Supplement 21.10, "Safe Handling of Beryllium and Its Compounds."

The LLNL Health Hazard Communication Program, documented in Health and Safety Manual Supplement 7.02, implements the OSHA hazard communication standard, 29 CFR 1910.1200. This program outlines management responsibilities as required by OSHA in training employees:

- methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area
- physical and health hazards of chemicals in the work area
- measures employees can take to protect themselves from these hazards
- details of the hazard communication program

Relevant training courses for implementing these requirements are:

HS-0001	New Employee Orientation
HS-4050	Health Hazard Communication for Supervisors
HS-4052	Health Hazard Communication for Supervisors of Chemical Laboratories

There are several options for providing chemical specific training to employees:

- lecture, computer-based, and web-based classes in specific hazards are available for a limited number of topics
- specialized training can be developed on request by the ES&H Team
- supervisor may provide training

A formal beryllium training course exists as HS-4255, "Beryllium." This course is available both in an instructor presented format as well the recently developed web-based course, HS-4255-W (url: http://www-training.llnl.gov/wbt/). This course does not currently present risks associated with beryllium exposure commensurate with DOE N440.1 and needs to be improved.

LLNL is a participant in the DOE/EH-61 and DOE/DP-45 sponsored Beryllium Risk Communication Task Force being managed by the Oak Ridge Institute for Science and Education (ORISE).

The Hazard Assessments (Sections 2 and 3, above) identify those workers that require beryllium health hazard training. Required training is documented in FSP's, OSP's, and the directorate training plans. Persons requiring beryllium training can also self-identify by completing the Livermore Training Records and Information Network (LTRAIN) questionnaire. (LTRAIN is a systematic questionnaire whereby training appropriate to any task at LLNL is identified.)

When a formal training class is completed a record is maintained in the Laboratory Repository of Complete Courses (LROCC) database. Training records for informal or specialized training are maintained by the supervisor or directorate training coordinator in accordance with directorate policy.

Actions Completed

Draft of a beryllium risk communication class consistent with DOE N440.1 have been developed and is undergoing review by the Beryllium Training Task Force.

Copies of DOE N440.1, the draft Implementation Guide for DOE N440.1, and the draft Defense Programs Beryllium Good Practices Guide were provided to the ES&H Team Industrial Hygienists on July 25, 1997.

Actions in Process

Identifying workers requiring beryllium health hazard training. (Estimated completion: 4/98)

Provide training for industrial hygienists, Health and Safety Technicians, and other health and safety professionals responsible for implementing aspects of the beryllium program in the elements of DOE N440.1 and LLNL implementation of the notice. (Estimated completion date: 3/98)

Participant in ORISE Beryllium Training Task Force.

Update HS-4255. (Completion date dependent on completion of ORISE training program.)

7. Recordkeeping

Hazards Assessments

Hazard Assessments are written by the Industrial Hygienist according to IHPIM #50, "Exposure Assessment and Monitoring Plan." Copies are forwarded to the individual responsible for the operation, to Respirator Services, and to Health Services.

Respirator Services reviews the Hazard Assessment for adequacy maintains the file of all current and expired Hazard Assessments.

Health Services reviews the Hazard Assessments and files them according to Health Services Policy/Procedure "Handling ES&H Information" of November 3, 1997. The ES&H Team clinician reviews the assessment and files it in the Health Services ES&H building files, if, in the judgment of the clinician, the hazard assessment has information of significant impact on worker health, a copy is placed in the worker's medical chart.

Sampling Data

Relevant data for all samples for analysis (air samples, swipe samples, bulk samples, and bioassay) are entered in the Hazards Control Department exposure database, STAR (Sample Tracking and Reporting System). Every sample is identified with a unique number and sufficient data to identify the operation, and if appropriate, the person sampled.

After the samples are delivered to the Hazards Control Analytical Laboratory, the STAR data is electronically transmitted to the Analytical Laboratory, samples are analyzed in accordance with established procedures, and a laboratory report is generated. The completed report is then forwarded to the individual(s) identified in STAR.

Exposure Reports

Results of all exposure sampling are documented in exposure reports according to IH-PIM #52, "Personal Monitoring Reports." This policy is provided as Appendix F. The reports include (as a minimum) the following information:

- Actual measured exposure.
- Calculated 8-hour time weighted average, excursion, short-term or ceiling exposure level, with a brief discussion of the relevance of this figure.
- Relevant exposure limits.
- Types of personal protective equipment used (respirator, gloves, etc. - specify type of each).
- Where overexposures are determined, regardless of the use of a respirator, state recommendations for improving engineering, administrative or personal protective control measures to reduce exposure.
- Additional training requirements based on results.
- Additional medical surveillance requirements based on results.
- Need for additional monitoring (if any).
- Reference to appropriate sections of Health and Safety Manual or Supplements or OSHA standards (Federal and California, as appropriate).
- Statement of supervisors responsibility for employee notification.

The report is generally addressed to the supervisor, with copies to the affected individuals, appropriate program management, Health Services, the ES&H Team files, Hazards Control Department files, and other individuals as appropriate.

Actions in Progress

(1) Hazard Assessments and sample recordkeeping are an ongoing activity.

(2) IHPIM #52 (Exposure Reports) is currently under revision to streamline the process.

Estimated date for completion

(1) Ongoing.

(2) January 1, 1998.

8. Performance Feedback

IHPIM #52, Personal Monitoring Reports, provides the format to inform management on the adequacy of controls and work practices by analyzing exposure results. If the exposure exceeds the administrative action level of 0.2 $\mu g / m^3$ or exposure standard of 2 $\mu g / m^3$, actions identified in Table 2 of section 4 of this implementation plan shall be followed. If actual exposures exceeds the standard (that is, exposure without the use of respiratory protection or if the protection factor of the respirator is exceeded) then verbal notification of the supervisor, ES&H Team Leader, Industrial Hygiene Technical Leader, and Health Services is required. The area Assurance Officer, in consultation with the responsible industrial hygienist, Industrial Hygiene Technical Leader, ES&H Team Leader, Program Management, will determine if an occurrence report is required. If so, the LLNL implementation procedures of DOE Order 230.1 will be followed. The report will provide a description of the overexposure and corrective actions being implemented.

After changes are made to any process involving beryllium which result in uncharacterized exposures, the ES&H Team will re-evaluate the controls to verify their adequacy.

Workers in the beryllium medical surveillance program who have abnormal laboratory tests, or who present symptoms that may be indicative of beryllium disease, will be scheduled for repeat or confirmatory tests, or offered further medical evaluation at the discretion of the treating physician. Specific information is provided in Appendix G.

Actions in Progress

University of California ES&H Panel is working with the University of California Office of the President to establish policy on appropriate protection for workers sensitized to beryllium or with confirmed diagnosis of chronic beryllium disease.

Estimated date for completion

Not yet established.

Appendices

Appendix A: DOE Notice 440.1

Appendix B: Supplement 21.10

Appendix C: IH-01

Appendix D: IH-14

Appendix E: IHPIM #50

Appendix F: IHPIM #52

Appendix G: Draft Medical Surveillance of Beryllium Exposed Workers

U.S. Department of Energy
NOTICE
Washington, D.C.

DOE N 440.1

7-15-97

SUBJECT: INTERIM CHRONIC BERYLLIUM DISEASE PREVENTION PROGRAM

1. PURPOSE. To establish a chronic beryllium disease prevention program (CBDPP) that enhances, supplements and is integrated into the worker protection program requirements of Department of Energy (DOE) Order 440.1, "Worker Protection Management for DOE Federal and Contractor Employees." This program is designed to reduce the number of current workers exposed, minimize the levels of beryllium exposure and the potential for exposure to beryllium, and establish medical surveillance protocols to ensure early detection of disease.

2. APPLICABILITY.

   a. DOE Elements. Except for the exclusions in paragraph 2c below, this Notice applies to all DOE Elements with operations involving exposure and the potential for exposure to insoluble forms of beryllium at DOE-owned or-leased facilities.

      (1) For the purpose of this Notice, beryllium means elemental beryllium and any insoluble beryllium compound or alloy containing 0.15 percent beryllium or greater that may be released as an airborne particulate.

      (2) Beryllium articles are not covered by this Notice. A beryllium article is a manufactured item formed to a specific shape or design during manufacture that has end-use functions dependent in whole or in part on its shape or design during end use, and that does not release or otherwise result in exposure to airborne concentrations of beryllium under normal conditions of use.

   b. Contractors. Except for the exclusions in paragraph 2c below, the Contractor Requirements Document (CRD), Attachment 2, sets forth requirements that are to be applied to contractors awarded contracts, including integrating contractors, (and subcontractors thereunder) for the operation and management of DOE-owned or -leased facilities where there is exposure and the potential for exposure to beryllium. Contractor compliance with the CRD will be required to

the extent set forth in a contract.

c. Exclusions. This Notice does not apply to:

(1) DOE laboratory operations involving beryllium that are subject to the requirements of 29 CFR 1910.1450, "Occupational Exposure to Hazardous Chemicals in Laboratories."

(2) The Naval Nuclear Propulsion Program, which is covered under Executive Order 12344, Public Law 98-525 (42 United States Code (U.S.C.) 7158, Note), is responsible for establishing standards to ensure adequate protection for workers, the public, and the environment for facilities and activities under Naval Nuclear Propulsion Program cognizance.

3. CHRONIC BERYLLIUM DISEASE PREVENTION PROGRAM OBJECTIVES. The objectives for DOE's CBDPP are directed toward achieving the goal of preventing future cases of chronic beryllium disease (CBD) resulting from DOE activities. DOE's objectives are to:

a. Conduct comprehensive inventory and hazard assessments for beryllium by qualified professional industrial hygienists to ensure that current workers not involved with beryllium activities or processes and the public are not exposed to beryllium.

b. Minimize the number of current workers and their exposure when beryllium is a potential or known hazard, by providing appropriate levels of controls and exposure reduction and minimization measures and goals for beryllium work activities where potential risk of exposure to beryllium warrants.

c. Conduct medical surveillance on beryllium-exposed current workers to ensure the early detection of disease and beryllium sensitization prior to diagnosis of CBD.

d. Collect and analyze performance feedback data in the form of exposure monitoring and medical surveillance results to demonstrate the effectiveness of the CBDPP and to enhance the program.

4. REQUIREMENTS. DOE Elements shall:

a. Implement a CBDPP that augments and is integrated into the safety and health program requirements specified in DOE Order 440.1 (5483.1B, 5480.4, 5480.8A, and 5480.10 for operations contractually not covered by 440.1), for the protection of current workers from the hazards of occupational exposures to beryllium.

In addition, integrate the CBDPP into those operations or activities covered under 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response," and into the sites Integrated Safety Management Program.

b. Include in the CBDPP written plans, schedules, and other measures for achieving the objectives and requirements of this Notice. The program shall address, at a minimum, the following elements: baseline inventory and sampling, hazard assessment, medical surveillance, exposure monitoring, training, exposure reduction and minimization, recordkeeping, and performance feedback.

c. Comply with Attachment 1, which lists the program performance elements necessary for the development of CBDPPs.

d. Ensure all aspects of the CBDPP are managed and implemented by professionally and technically qualified industrial hygienists and medical personnel.

5. RESPONSIBILITIES. Heads of Departmental Elements shall:

a. Require initiators of procurement requests to identify in those requests whether the CRD for this Notice applies to contractors (and subcontractors thereunder), and also identify any special instructions for the application of the CRD.

b. Within 90 days after the effective date of this Notice, initiate negotiations for application of the CRD for this Notice to existing contracts (and subcontracts thereunder).

c. Require that contractors submit CBDPPs to their DOE Field Organizations for review and have approved CBDPPs within 6 months after the effective date of this Notice.

d. FOR DEFENSE PROGRAMS CONTRACTORS ONLY: Submit CBDPPs to the Assistant Secretary for Defense Programs (DP-1) for review and have approved CBDPPs within 6 months after the effective date of this Notice.

e. Review and approve all contractor CBDPPs.

f. Modify the requirements of this Notice for a contractor or subcontractor when necessary to accommodate the obligations of a contractor whose employees are represented for collective bargaining purposes by a labor organization consistent

with the requirements of the National Labor Relations Act.

6. CONTACTS.

a. Consult the Implementation Guide associated with this Notice when establishing a CBDPP.

b. For technical interpretations related to CBDPPs, consult the DOE Technical Information Services database, or call the DOE Response Line at (800) 292-8061.

FEDERICO F. PEÑA
Secretary of Energy

ATTACHMENT 1

PERFORMANCE ELEMENTS FOR DEVELOPMENT OF A CHRONIC BERYLLIUM DISEASE PREVENTION PROGRAM

CHRONIC BERYLLIUM DISEASE PREVENTION PROGRAM. DOE Elements shall implement the following that augments and is integrated into the worker protection program requirements specified in DOE Order 440.1, paragraphs 4.a. through m. and Attachment 1, paragraph 5.

1. Baseline Inventory and Sampling. Develop a baseline inventory of beryllium locations and operations; identify exposed and potentially exposed current workers by location; and conduct sampling.

    a. Conduct a records review and employee interviews.

    b. Document the presence and locations of beryllium on site.

    c. Conduct, where appropriate, the monitoring required by paragraphs 3.b. through d. below.

2. Hazard Assessment.

    a. Conduct a beryllium hazard assessment and determine whether in-depth analysis is warranted.

    b. Conduct in-depth analysis, where appropriate, to ascertain the nature of the exposure risk to beryllium.

    c. Include in the beryllium hazard assessment an analysis of existing conditions, exposure data, medical surveillance trends, and the exposure potential of planned activities.

3. Exposure Monitoring.

    a. Identify the operations and areas in which workers must be monitored.

    b. Conduct personal breathing zone sampling for all workers exposed and potentially

exposed to beryllium, or provide the rationale for monitoring a limited subset of workers.

c. Conduct area sampling where appropriate to determine operational control.

d. Conduct surface sampling to determine housekeeping conditions and to identify contamination that has the potential to become airborne.

e. Establish the required frequency of monitoring by using a risk-based (tailored) approach.

f. Require additional monitoring when warranted due to changes in operations or procedures, or as necessary to ensure that exposure reduction and minimization goals are met.

4. Exposure Reduction and Minimization. Manage and control exposures to beryllium by: reducing airborne levels of beryllium as-low-as-practical, minimizing the number of current workers exposed and potentially exposed to beryllium, minimizing the number of opportunities to be exposed, and setting reasonable exposure reduction and minimization goals using a risk-based (tailored) approach. Elements of reduction and minimization strategies include:

a. Developing a documented program that includes exposure reduction and minimization goals using a risk-based (tailored) approach, a plan for meeting goals, measures that will be used to assess status of attaining goals, and the rationale for determining reduced and minimized exposures.

b. Using administrative action levels that trigger actions to reduce or minimize worker exposure and the potential for exposures.

c. Establishing contamination control to preclude exposures to the extent practical.

d. Implementing work control strategies to reduce exposures to as-low-as-practical using the established hierarchy of industrial hygiene controls (i.e., engineering and administrative controls, and personal protective equipment) and to reduce the potential for worker exposure.

e. Documenting the rationale used for determining reduced and minimized exposures.

5. Medical Surveillance. Offer to enroll in a medical surveillance program all workers at risk for chronic beryllium disease (CBD) due to exposure or potential exposure to beryllium.

a. Maintain an updated roster of workers at risk for CBD.

b. Conduct pulmonary medical histories and lung function tests as part of the preplacement examination for workers to be assigned to beryllium areas. If the occupational medicine physician concludes that the medical history and the lung function test results warrant a chest x-ray, it must be offered to the worker.

c. Provide on a voluntary basis, beryllium-specific peripheral blood lymphocyte proliferation testing, or other available preferred beryllium-specific tests considered appropriate by an occupational medicine physician, to screen for beryllium sensitization and provide early detection of CBD. Physicians must notify workers of the procedures and associated risks of the tests.

d. Workers' occupational histories and clinical stages of the disease must be included in investigation reports of recordable beryllium disease (see DOE Order 231.1). Contact DOE (EH-6) for guidance on the content of the reports. Send copies of reports to DOE (EH-6).

6. Training. Implement a training program that provides workers exposed and potentially exposed to beryllium, and supervisors, managers, medical personnel, industrial hygienists, and others involved in beryllium activities and processes, with information concerning the proper handling and control of beryllium, hazards of exposure to beryllium, controls (e.g., engineering, administrative, and personal protective equipment) and work practices of the job assignment, minimization of worker exposure, the purpose and use of personal protective equipment, medical monitoring, and waste management and decontamination procedures.

7. Recordkeeping.

a. Maintain records of all beryllium inventory information, hazard assessments, exposure measurements, controls, and medical surveillance pursuant to DOE Order 440.1 paragraph 4.i.(2) to demonstrate program effectiveness.

b. Maintain the records in an electronic, easily retrievable manner for transmittal to DOE Headquarters on request.

c. Create links between data sets on working conditions and health outcomes to serve as a basis for understanding the beryllium health risk.

8. Performance Feedback.

   a. Conduct periodic analysis and assessment of monitoring results, hazards identified, medical surveillance results, attainment of exposure reduction and minimization goals, and occurrence reporting data.

   b. Feed back results to line managers, planners, worker protection staff, workers, medical staff, and others to ensure that needed information is available to maintain and improve all elements of the CBDPP continuously.

ATTACHMENT 2

CONTRACTOR REQUIREMENTS DOCUMENT (CRD)

PERFORMANCE ELEMENTS FOR DEVELOPMENT OF A CHRONIC BERYLLIUM DISEASE PREVENTION PROGRAM (CBDPP)

The contractor shall comply with the requirements contained herein and apply the requirements of this CRD to the subcontractors awarded subcontracts involving exposure and the potential for occupational exposure to beryllium at a DOE-owned or -leased facility.

1. Implement a CBDPP that augments and is integrated into the worker protection program requirements specified in DOE Order 440.1 (5483.1B, 5480.4, 5480.8A, and 5480.10 for operations contractually not covered by 440.1), for the protection of workers from the hazards of occupational exposures to beryllium. In addition, integrate the CBDPP into those operations or activities covered under 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response," and into the sites Work Smart Standards Process and Integrated Safety Management Program.

2. Submit CBDPPs to DOE Departmental Elements for review and have approved CBDPPs within six months after the effective date of this Notice.

3. FOR DEFENSE PROGRAMS CONTRACTORS ONLY: Submit CBDPPs to the Assistant Secretary for Defense Programs (DP-1) for review and have approved CBDPPs within 6 months after the effective date of this Notice.

4. Include in the CBDPP written plans, schedules, and other measures for achieving the objectives of DOE Notice 440.1 and requirements of this CRD. The program shall address at a minimum, the following: baseline inventory and sampling, hazard assessment, exposure monitoring, medical surveillance, training, exposure reduction and minimization, recordkeeping, and performance feedback. The CBDPP shall be approved by the contractor's site senior health and safety executive and the Head of the DOE Field Organization.

5. The objectives for DOE's CBDPP are to:

    a. Conduct comprehensive inventory and hazard assessments for beryllium by qualified professional industrial hygienists to ensure that current workers and the public are not exposed to beryllium.

b. Minimize the number of current workers and their exposure when beryllium is a potential or known hazard, by providing appropriate levels of controls and exposure reduction and minimization measures and goals for beryllium work activities where potential risk of exposure to beryllium warrants.

c. Conduct medical surveillance on beryllium-exposed current workers to ensure the early detection of disease and beryllium sensitization prior to diagnosis of chronic beryllium disease (CBD).

d. Collect and analyze performance feedback data in the form of exposure monitoring and medical surveillance results to demonstrate the effectiveness of the CBDPP and to enhance the program.

6. Ensure all aspects of the CBDPP are managed and implemented by professionally and technically qualified industrial hygienists and medical personnel.

7. CHRONIC BERYLLIUM DISEASE PREVENTION PROGRAM. Implement the following that augments and is integrated into the worker protection program requirements specified in DOE Order 440.1, Attachment 2, "Contractor Requirements Document."

a. Baseline Inventory and Sampling. Develop a baseline inventory of beryllium locations and operations; identify exposed and potentially exposed current workers by location; and conduct sampling.

(1) Conduct a records review and employee interviews.

(2) Document the presence and locations of beryllium on site.

(3) Conduct, where appropriate, the monitoring required by paragraphs 7.c.(2) through (4) below.

b. Hazard Assessment.

(1) Conduct a beryllium hazard assessment and determine whether in-depth analysis is warranted.

(2) Conduct in-depth analysis, where appropriate, to ascertain the nature of the exposure risk to beryllium.

(3) Include in the beryllium hazard assessment an analysis of existing conditions, exposure data, medical surveillance trends, and the exposure potential of planned activities.

c. Exposure Monitoring.

(1) Identify the operations and areas in which workers must be monitored.

(2) Conduct personal breathing zone sampling for all workers exposed and potentially exposed to beryllium, or provide the rationale for monitoring a limited subset of workers.

(3) Conduct area sampling where appropriate to determine operational control.

(4) Conduct surface sampling to determine housekeeping conditions and to identify contamination that has the potential to become airborne.

(5) Establish the required frequency of monitoring by using a risk-based (tailored) approach.

(6) Require additional monitoring when warranted due to changes in operations or procedures, or as necessary to ensure that exposure reduction and minimization goals are met.

d. Exposure Reduction and Minimization. Manage and control exposures to beryllium by: reducing airborne levels of beryllium to as-low-as practical, minimizing the number of current workers exposed and potentially exposed to beryllium, minimizing the number of opportunities to be exposed, and setting reasonable exposure reduction and minimization goals using a risk-based (tailored) approach. Elements of reduction and minimization strategies include:

(1) Developing a documented program that includes exposure reduction and minimization goals using a risk-based (tailored) approach, a plan for meeting goals, measures that will be used to assess status of attaining goals, and the rationale for determining reduced and minimized exposures.

(2) Using administrative action levels that trigger actions to reduce or minimize worker exposure and the potential for exposures.

(3) Establishing contamination control to preclude exposures to the extent practical.

(4) Implementing work control strategies to reduce exposures to as-low-as-practical using the established hierarchy of industrial hygiene controls (i.e., engineering and administrative controls, and personal protective equipment) and to reduce the potential for worker exposure.

(5) Documenting the rationale used for determining reduced and minimized exposures.

e. Medical Surveillance. Offer to enroll in a medical surveillance program all workers at risk for chronic beryllium disease (CBD) due to exposure or potential exposure to beryllium.

(1) Maintain an updated roster of workers at risk for CBD.

(2) Conduct pulmonary medical histories and lung function tests as part of the preplacement examination for workers to be assigned to beryllium areas. If the occupational medicine physician concludes that the medical history and the lung function test results warrant a chest x-ray, it must be offered to the worker.

(3) Provide on a voluntary basis, beryllium-specific peripheral blood lymphocyte proliferation testing, or other available preferred beryllium-specific tests considered appropriate by an occupational medicine physician, to screen for beryllium sensitization and provide early detection of CBD. Physicians must notify workers of the procedures and associated risks of the tests.

(4) Workers' occupational histories and clinical stages of the disease must be included in investigation reports of recordable beryllium disease (see DOE Order 231.1). Contact DOE (EH-6) for guidance on the content of the reports. Send copies of reports to DOE (EH-6).

f. Training. Implement a training program that provides workers exposed and potentially exposed to beryllium, and supervisors, managers, medical personnel, industrial hygienists, and others involved in beryllium activities and processes, with information concerning the proper handling and control of beryllium, hazards of

exposure to beryllium, controls (e.g., engineering, administrative, and personal protective equipment) and work practices of the job assignment, minimization of worker exposure, the purpose and use of personal protective equipment, medical monitoring, and waste management and decontamination procedures.

g. Recordkeeping.

(1) Maintain records of all beryllium inventory information, hazard assessments, exposure measurements, controls, and medical surveillance pursuant to DOE Order 440.1 paragraph 4.i.(2) to demonstrate program effectiveness.

(2) Maintain the records in an electronic, easily retrievable manner for transmittal to DOE Headquarters on request.

(3) Create links between data sets on working conditions and health outcomes to serve as a basis for understanding the beryllium health risk.

h. Performance Feedback.

(1) Conduct periodic analysis and assessment of monitoring results, hazards identified, medical surveillance results, attainment of exposure reduction and minimization goals, and occurrence reporting data.

(2) Feed back results to line managers, planners, worker protection staff, workers, medical staff, and others to ensure that needed information is available to maintain and improve all elements of the CBDPP continuously.

Appendix B.

This appendix is Supplement 21.10 to the LLNL Health and Safety Manual. The current version is available through LLNL only Home Page.

Return to: George Fulton, Hazards Control Department, L-383

BERYLLIUM DISEASE PREVENTION PROGRAM
OCCUPATIONAL EXPOSURE HISTORY QUESTIONNAIRE

Please select the best answer for each question. Please use a pen to fill out the questionnaire. Write your answers clearly. **If participating in the LANL study all identifying information will be removed.**

Name: _____ **Today's Date:** _____

Job Title: _____ **Telephone Extension:** _____

_____

LLNL Employee #: _____ **L-Code:** _____ **Date of Birth:** _____
month / day / year

Home Address: _____ **Sex:** Male ❑ Female ❑

Race-Ethnic Group: White ❑ Black ❑ American Indian ❑ Hispanic ❑ Asian ❑ Other ❑

These questions apply to your occupational (job) history. Please answer each question as best you can.
NOTE: The word "beryllium" means beryllium metal, beryllium containing alloy, beryllium ceramic or any beryllium compound, unless a specific form is being discussed in a question.

1) Please list the time period (month & year) that you started work at LLNL:

Began: month _____ year _____

2) Please list the job(s) you held, the approximate dates that you worked in this capacity, and the building(s) you worked in for each of these jobs while employed at LLNL. Start with most recent and please use another piece of paper if necessary.

Functional Job Title	Date	Bldg/Room	Matrix/Payroll Supervisor	Beryllium Exposure? Yes	No
				❑	❑
				❑	❑
				❑	❑
				❑	❑
				❑	❑

3a) While at LLNL did you ever work with beryllium? Yes ❑ No ❑
3b) Did you ever work in a building where others, but not you, worked with beryllium? Yes ❑ No ❑

4) If you answered yes to the beryllium exposure question (3 a or b), please describe in detail in what way(s) you feel you may have been exposed to beryllium? _____

_____

_____

_____

5) Other than at LLNL have you ever worked with beryllium? Yes ❑ No ❑

If yes, where (name and location of company)? _____

6) Did you ever work: (General Pulmonary Background Questions, please check the correct answer and fill in years job started and ended)

In a mine?	Yes ❑	No ❑	year started _____	year ended _____
In a quarry?	Yes ❑	No ❑	year started _____	year ended _____

6) (continued from prior page)

In a foundry? Yes ❑ No ❑ year started _____ year ended _____

In a pottery? Yes ❑ No ❑ year started _____ year ended _____

With asbestos? Yes ❑ No ❑ year started _____ year ended _____

In a cotton, flax or hemp mill? Yes ❑ No ❑ year started _____ year ended _____

7) Did you machine, polish, grind, or otherwise cut beryllium? Yes ❑ No ❑

If yes, how many months total? _____ What year(s)? _____

Did you do this work outside of a glovebox or other enclosure? Yes ❑ No ❑

8) Did you work with powdered beryllium? Yes ❑ No ❑

If yes, how many months total? _____ What year(s)? _____

Did you do this work outside of a glovebox or other enclosure? Yes ❑ No ❑

9) Did you work with hot beryllium metal (heat treating, welding, etc.)? Yes ❑ No ❑

If yes, how many months total? _____ What year(s)? _____

Did you do this work outside of a glovebox or other enclosure? Yes ❑ No ❑

10) Did you work in or near a foundry when beryllium was used? Yes ❑ No ❑

If yes, how many months total? _____ What year(s)? _____

11) Were you involved in decontamination of beryllium-contaminated equipment or facilities?

Yes ❑ No ❑

If yes, how many months total? _____ What year(s)? _____

12) Were you involved with work or on maintenance of beryllium plenums and / or ventilation ducts?

Yes ❑ No ❑

If yes, how many months total? _____ What year(s)? _____

13) Have you performed any of the following jobs in a building where beryllium is used (or on potentially beryllium contaminated equipment or supplies such as laundry)?

	Yes	**How many months total?**	**What year(s)?**
Administrative Support	❑	_____	_____
Custodian	❑	_____	_____
Electrician	❑	_____	_____
Inspector	❑	_____	_____
Laundry	❑	_____	_____
Plumber	❑	_____	_____
Security Guard	❑	_____	_____
Site 300 Shot Tables	❑	_____	_____
Other: _____	❑	_____	_____

14) Have you been in any significant beryllium exposure incidents / accidents? Yes ❑ No ❑

If yes, please describe: _____

HC Field Support Instruction **Instruction # IH-01**

From:	Industrial Hygiene	Supersedes
Issue Date:	October 1, 1991	Effective Period: Indefinite
Revision Date:	February 1, 1996	Review Date: February 1, 1996

SUBJECT: **IH PROBLEM IDENTIFICATION** - HAZARDOUS AREAS

FREQUENCY: **Monthly**

PURPOSE: Assist in identifying Industrial Hygiene problems as they arise.

Required By: H & S Manual (Chapters 1.02, 21.03, 26, 30, 34)

Responsibility: Health & Safety Technician

> **Note:** This instruction performed for Industrial Hygiene may be accomplished in conjunction with general safety tours requested by the other safety disciplines (e.g., Health Physics, Industrial Safety, Fire Protection).

INSTRUCTION:

1. Conduct walk-through surveys in buildings and areas where toxic or hazardous chemical or physical agents are used or stored. Pay particular attention to new materials and equipment, experimental changes, and significant modifications or renovation of laboratories or shops. For guidance, use the attached list of major industrial hygiene concerns.

2. Report problems to local program or operations supervision. The Industrial Hygienist and ES&H Team Leader should be notified of important items, items that require further evaluation using a Hazard Assessment or those that cannot be resolved in a reasonable period of time.

3. "Hazardous Areas" shall be determined by the Industrial Hygienist.

DOCUMENTATION:

Document problems or concerns in the Technician Log Book and inform the Team IH if immediate action is needed.

LIST OF MAJOR INDUSTRIAL HYGIENE CONCERNS

I. Chemicals
- A. Toxic or flammable liquids
- B. Organic chemicals - pure chemicals plus mixtures such as adhesives
- C. Corrosives - acids/bases/organic corrosives
- D. Carcinogens, Teratogens, Mutagens, Fetotoxins
- E. Coal tars/oil shales/pyrolysis and thermal decomposition of organic materials
- F. Explosives
- G. Cryogenic materials in potentially confined spaces
- H. Compressed gasses- toxic, flammable or asphyxiant

II. Metals and Minerals
- A. Asbestos
- B. Beryllium
- C. Mercury
- D. Lead
- E. Welding/soldering/brazing fumes-especially silver brazing, stainless steel welding or cutting
- F. Fibrous dusts other than Asbestos
- G. Nuisance dusts

III. Physical Agents
- A. Noise and vibration
- B. Non-ionizing radiation- Microwave and radio frequency sources
- C. Magnetic fields
- D. Heat stress/cold stress

IV. Biological Agents

V. Special Concerns
- A. Confined space entries
- B. Plumbing cross-connections
- C. Sanitation
- D. Ventilation
- E. HEPA filters
- F. Respirators
- G. Drum storage
- H. Toxic material vacuums
- I. Mercury vacuums
- J. Spray painting

FACILITIES DESIGNATED AS HAZARDOUS AREAS

Building	Subarea(s)	Hazard Type

HC Field Support Instruction **Instruction # IH-14**

From:	Industrial Hygiene	Supersedes
Issue Date:	October 1, 1991	Effective Period: Indefinite
Revision Date:	February 1, 1996	Review Date: February 1, 1996

SUBJECT: **BERYLLIUM MONITORING**

FREQUENCY: **As specified**

PURPOSE: Whenever beryllium is used in a dispersible form or where dust may be generated, periodic monitoring is required.

Required By: H & S Manual (Supplement 21.10), 29 CFR 1901.1000

Responsibility: Health & Safety Technician or Industrial Hygienist

INSTRUCTION:

1. Areas where beryllium and its compounds are used in a dispersible form or where dust may be generated require appropriate engineering, administrative and PPE controls. Initial and periodic personal air samples should be collected and analyzed to assure that breathing zone concentrations are below current limits. Area air samples and surface swipes may be taken to establish contamination levels and determine the effectiveness of controls. Routine monitoring is then established based on the airborne levels of beryllium as follows:

   High airborne ($\geq$ 2.0 µg/m^3)
   - Daily personal air samples shall be taken of all individuals performing beryllium work.
   - Weekly area air samples and/or surface swipes shall be taken in locations determined by the Team IH.

   Moderate airborne ($\geq$ 0.2 µg/m^3 but < 2.0 µg/m^3)
   - Personal air samples shall be taken at least annually or at the frequency established by the Team IH.
   - Periodic area air samples and/or surface swipes shall be taken as directed by the Team IH for the type of operation.

   Low airborne (< 0.2 µg/m^3)
   Personal air samples, area air samples and surface swipes shall be taken at the request of the Team IH.

2. Entrances to beryllium work areas should be posted with appropriate warning signs and beryllium storage areas (such as dry boxes), potentially contaminated equipment and working surfaces must be labeled. Requirements for personal

protective equipment shall be stipulated by the IH on the Hazard Assessment form, FSP or OSP.

3. The attached schedule of beryllium monitoring frequencies is based on current operations and must be modified as operations change. Inform the Team IH of changes in beryllium operations and discuss appropriate monitoring locations and frequencies.

DOCUMENTATION:

Input sampling data into STAR and deliver the samples to the IH Analytical Lab for analysis. Request that the IH Analytical Lab send the results to the Team IH.

Copies of the forms are provided with IH-12.

SCHEDULE OF BERYLLIUM MONITORING

Building and Room	Frequency	Personal Air	Area Air	Surface Swipes

50

EXPOSURE ASSESSMENT AND MONITORING PLAN

TABLE OF CONTENTS

1.0 Purpose

Exposure assessment is performed to anticipate, recognize, evaluate, and control potential workplace hazards so that all employees are assured a safe and healthful work environment. The LLNL workplace involves a large variety of hazards, constantly changing operations and a mobile group of workers. Evaluation of these complex situations requires a sound, logical workplace exposure assessment and monitoring strategy to focus industrial hygiene, occupational medicine, and other occupational health resources on those work situations with the greatest risk or potential for adverse health effects. The LLNL Exposure Assessment and Monitoring Plan will provide a consistent, systematic framework to accomplish at least the following five goals:

1. Assess potential health risks faced by all workers, differentiate between acceptable and unacceptable exposures, and control unacceptable exposures;

2. Establish and document records of all potentially exposed workers and communicate exposure monitoring results to each worker;

3. Referral of specific groups of exposed employees to Health Services for medical evaluation and surveillance;

4. Compliance with regulations and exposure guidelines; and

5. Efficient and effective allocation of time and resources to accomplish the above four goals.

2.0 SCOPE

This plan outlines a strategy for how industrial hygiene exposure assessment and monitoring will be implemented at LLNL. This plan goes beyond compliance and provides a comprehensive and integrated approach to the characterization of chemical, biological and physical (noise, non-ionizing radiation, and temperature extremes) stressors. A risk based approach will be used to focus industrial hygiene and occupational medical resources to those areas of greatest risk.

Exposure assessment and monitoring records will be computerized starting July, 1995 and made available to authorized Health Services and Hazards Control personnel. Since this system will contain sensitive data, access will be protected from unauthorized users. Reports of exposure monitoring activities will be sent to potentially exposed employees, supervisors and ES&H assurance managers.

3.0 DEFINITIONS

Acute	having a sudden onset, sharp rise, and short course; may apply either to exposures in the workplace or to physiological response.
Administrative Controls	methods of controlling employee exposures to various hazards by posting warnings, requiring training, limiting access to authorized personnel, and following approved safety procedures and/or work practices.
Agent	a chemical, physical, or biological entity that may cause deleterious effects in an exposed worker. Also known as an environmental agent or stressor.
Area Sample	an environmental sample collected at a fixed point in the workplace; reflects workplace contaminant concentrations that may not correlate with personal samples of an individual worker's exposure.
Baseline	exposure measurements that describe the magnitude and range of exposures for a given exposure group and agent. The baseline often serves as a comparison for subsequent monitoring data.
Breathing Zone	the sphere of air surrounding the worker's head, generally assumed to have a diameter of 2 feet, from which air is breathed.
Carcinogen	an agent that potentially causes induction of tumors (cancer) following exposure. See *Health & Safety Manual Supplement 21.16* for lists of carcinogens and safe handling guidance.
Ceiling	an air contaminant concentration or level of exposure to an agent that should not be exceeded, even for brief time intervals.
Chronic	marked by long duration or frequent recurrence; not acute. May refer either to workplace exposures or to the disease or injury state resulting from such exposure.
Compliance Monitoring	technique for evaluating compliance with regulatory standards; typically, the maximally exposed worker(s) are identified and monitored for exposure to agents. If that personal exposure is less than the standard, then all worker exposures are also assumed to be

	less. See *NIOSH Occupational Exposure Sampling Strategy*, Leidel and Busch, 1977.
Direct Measurement of Exposure	an approach to quantifying exposure by taking measurements of exposure at or near the exchange boundaries of a worker while the exposure is taking place (e.g., the personal air sample in a worker's breathing zone).
Dose	the amount of a substance available for interaction with metabolic processes of a worker following exposure and absorption. The amount of a substance crossing the exchange boundaries of skin, lungs, or digestive tract is termed absorbed dose; the amount available for interaction by any particular organ or cell is termed the delivered dose for that organ or cell.
Engineering Controls	methods of controlling employee exposures by physically modifying the hazard source to reduce hazard potential or magnitude. Typical engineering controls include glove boxes, exhaust hoods, ventilated enclosures, guards, shielding, sound absorbers, etc.
Exposure	potential contact at a worker's exchange boundaries (e.g., lung or skin) with chemical, physical, or biological agents. Effective exposure is quantified as the amount of the agent actually available for absorption at the exchange boundaries of the worker's body (e.g.; skin, lung tissue, digestive tract, and/or eyes), factoring in proper use of personal protective equipment.
Exposure Assessment	a systematic evaluation of the hazardous chemical, biological and physical agents associated with an operation for the purpose of identifying both acute and chronic health hazards. The assessment may be qualitative or quantitative in nature with the objective of assessing employee exposures to potentially hazardous stressors.
Exposure Group	a group of employees who experience agent exposures similar enough that monitoring agent exposures of any worker in the group provides data useful for predicting exposures of the remaining workers. The categorization of workers into such groups often involves categorization by operation, job category, and agents.
Exposure Pathway	the course that a chemical, physical or biological agent takes from the source to enter the worker's body.
Hazard Identification	the determination of whether a particular substance or chemical is causally linked to particular health effects (toxicological assessment).

Monitoring the act of collecting a sample from the environment for analysis to discover the concentration or intensity of a stressor or environmental agent.

Occupational Exposure Limit a generic term used to represent the agent concentration or intensity averaged over a time period to evaluate whether the measured values are within the allowable exposure limits (most conservative of DOE Orders, OSHA regulations, and ACGIH Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices). Abbreviated OEL.

Overexposure an average exposure greater than the OEL with the average taken over the appropriate time interval and considering the appropriate confidence interval or a brief exposure which exceeds a Ceiling limit.

Professional Judgment that capacity of an experienced professional to draw correct inferences from incomplete quantitative data, frequently on the basis of observations, analogy, and intuition.

Qualitative not based on rigorous quantitative analysis of data, rather primarily based on the integration of information and judgment.

Risk the probability of deleterious health or environmental effects. Risk is a function of exposure level and potency (health effect per unit exposure or dose).

4.0 RESPONSIBILITIES

4.1 Hazards Control Department

Implementation of the LLNL Exposure Assessment and Monitoring Plan is primarily the responsibility of the Industrial Hygiene staff.

Technical Support & Policy Development Division

The establishment of LLNL policy, maintenance of the Exposure Assessment and Monitoring Plan, and issues of technical support will be handled by the Technical Support & Policy Development (TSPD) Division of Hazards Control. TSPD management will provide an Industrial Hygiene Sampling Technician to perform baseline exposure monitoring and to instruct Health & Safety Technicians on monitoring and control techniques. This individual will be available to assist all Team Industrial Hygienists and his/her time will be coordinated and prioritized by TSPD.

ES&H Teams

Conducting and documenting exposure assessments and personal monitoring is the responsibility of the ES&H Team Industrial Hygienists. The ES&H Team Industrial Hygienists are encouraged to utilize the services of the Industrial Hygiene Sampling Technician or the ES&H Team Health & Safety Technicians to conduct monitoring.

Industrial Hygiene Laboratories

The Analytical Laboratory will analyze or arrange for analysis of all chemical samples collected and report results via the departmental Sample Tracking And Reporting (STAR) computer system. The IH Analytical Laboratory shall maintain its accreditation by AIHA.

The IH Instrument Laboratory will maintain and calibrate sampling and monitoring equipment and provide them, upon request, to the IH Sampling Technician, ES&H Team Industrial Hygienists or Health & Safety Technicians.

Respirator services will review hazard assessment and control forms before issuing respiratory protection to verify that trained personnel will use appropriate equipment for the documented operations.

Management Information Services Team (MIST)

MIST will maintain the computer database system of exposure assessment and monitoring information and ensure that all appropriate users have access. Information exchange between Hazards Control and Health Services will be facilitated and appropriate applications software developed and maintained.

4.2 Health Services Department

The Health Services Department is a primary user of the information generated by the Exposure Assessment and Monitoring Plan. The medical staff will utilize this information to assist in the health protection of employees. Specific areas where this information will be used include:

Initial and periodic examinations;

Hazard examinations, where an understanding of the work environment, workplace exposure and stressors present will enhance the occupational health professional's ability to contribute to the effectiveness of primary prevention and permit early detection of disease;

Annual medical approval of employees for respirator use;

Employees returning to work after extended absence for injury or disease;

Pregnancy evaluations; and

Medical surveillance studies in which health affects to a population of exposed workers are assessed.

Health Services, in coordination with the Industrial Hygiene staff, will maintain a list of personnel enrolled in special medical surveillance programs and will periodically review these programs. Health Services will also coordinate biological sampling of employees.

5.0 METHODOLOGY

The challenges in occupational exposure assessment are to recognize both real and potential exposures, to evaluate each as acceptable or unacceptable, and to recommend controls for all unacceptable exposures. Recognition of exposures involves considering the tasks, agents and workers. Workers may be exposed to environmental agents (chemical, physical, and biological) during the performance of tasks directly involving these agents, by incidental contact, or by the effects of nearby tasks performed by others. A credible exposure assessment strategy considers all sources of exposure.

Assessment of workplace operations must be conducted in an orderly and systematic manner to make best use of available resources. Prioritization for conducting exposure assessments should be based on risk: those perceived by employees; the real risk or hazard of the operation; and the risk of non-compliance with regulatory requirements.

Evaluation of the significance of exposures requires that both the time history and occupational exposure limit for the agent of concern to be understood. Concentrations and magnitudes of agents vary over both time and space. Workers move through these variable concentrations and magnitudes on variable paths and perform tasks that affect exposure. Most industrial hygiene decisions are based on a few representative exposure assessments. The acceptability of a workplace exposure is judged by comparing assessment results with occupational exposure limits (OELs). OELs are guidelines for good practice, not a fine line separating safe from dangerous conditions. The OEL represents an exposure to which most workers can be exposed regularly, day after day, without adverse health effects.

The most important aspect of conducting the exposure assessment is that it be conducted by an industrial hygiene professional with input from supervisors, area responsible persons, employees, Health Services clinicians and other resources that are familiar with the operation. The assessment will be documented on the Hazard Assessment and Control Form (see Appendix A).The assessment is comprised of the following four steps:

1. Initial characterization and, when applicable, establishment of exposure groups;

2. Qualitative assessment;

3. Quantitative assessment involving the collection of monitoring data; and

4. Data interpretation, communication of findings, recommendations, and reassessment.

5.1 Initial Characterization

The first step in an exposure assessment is to characterize the operation and identify all potentially hazardous exposures for personnel. This characterization will be conducted by the Industrial Hygiene staff in coordination with Health & Safety Technicians, supervisors, and the employees involved in the operation. A thorough understanding of the operation, the personnel, and the environmental agents are needed before the Industrial Hygienist can develop a plan to address the agents in some reasonable order of priority. Once these parameters are collected exposure groups may be defined.

5.2 Qualitative Assessment

Once the operation has been characterized the Industrial Hygienist conducts a qualitative assessment of exposure. The quantities, form and duration of exposure to hazardous agents are assessed in light of the engineering, administrative and personal protective controls in place. The Industrial Hygienist uses his/her professional judgment to indicate if baseline monitoring is necessary and documents the rationale for this decision. If baseline monitoring is not deemed necessary, the assessment is entered into the computer information system and the process is finished. For operations where monitoring data is needed to further define exposure, the process continues. The design of an efficient and effective monitoring campaign is facilitated if the various exposure groups have been assigned priorities for sampling on the basis of potential risk.

Exposure Rating

Workers within a task or process are often assigned to an exposure group that has relatively homogeneous exposure to a number of agents. The three tools that are used most often in preliminary exposure assessment are: (1) past exposure data; (2) exposure models; and (3) professional judgment of the Industrial Hygienist (analogy to other exposure situations).

Health-Effect Rating

Each agent needs to be evaluated subjectively for the severity of the potential health effect(s) and the uncertainty of the toxicology data (e.g., animal data versus human epidemiological evidence). The time interval for monitoring is based on the biological nature of the agent being evaluated. An agent with little or no rate-dependence, such as lead, should be distinguished from an acute irritant, such as chlorine, that causes adverse health effects within seconds or minutes of exposure.

Chronic agents (including those with toxic and extremely toxic health effects), carcinogens, and teratogens are not as easily rated as the acute health effects. Consequently, judgment may play a larger role than with acutely toxic materials

Qualitative Risk Ranking

Setting priority for evaluation and monitoring is particularly difficult when there are hundreds of agents and multiple exposure groups in a facility. A qualitative ranking scheme should be used to establish priorities between competing degrees of exposure and potential health effects. The same risk prioritized system as defined above will be used. Evaluation and monitoring will be conducted based on the following elements:

1. Perceived risk by employees as indicated by requests for evaluation or concerns directed to the Industrial Hygienist, ES&H Team or Health Services.

2. Operations recognized to have potentially hazardous conditions (real risk) of industrial hygiene concern by the presence of a written safety procedure or work permit (e.g., Operation Safety Procedure, Facility Safety Procedure, Confined Space Permit, Asbestos Work Permit, Lead Work Permit, Carcinogen Hazard Review, etc.). (See Chapter 2 of the *LLNL Health & Safety Manual*).

3. Operations involving materials of regulatory concern (e.g., OSHA regulated materials, carcinogens and reproductive toxins).

4. Other operations involving less hazardous agents.

5.3 Quantitative Assessment

Once a decision to monitor exposures of individuals or among workers in an exposure group has been made, the focus shifts towards devising a monitoring campaign that provides the most information possible per sample. Monitoring is the measurement of exposures or contaminant concentrations during a given period of time. Monitoring results can be used to quantitatively estimate exposures for individuals and groups of workers and to identify sources of potential exposure. The type of monitoring selected for a campaign is critically linked to the information needed by the Industrial Hygienist to complete the exposure assessment.

A monitoring strategy and campaign includes a model for exposure pathways, a clear statement of monitoring objectives , and a variety of monitoring methods . The Industrial Hygienist should start by defining the exposure pathways.

Exposure Pathway Model

The complexity of exposure scenarios requires consideration of all possible exposure pathways before monitoring techniques are selected. Without considering all pathways, the critical pathway may be overlooked. For instance, once an agent becomes airborne it may be inhaled, come in direct contact with the skin, or settle onto work surfaces and pose a skin absorption or ingestion hazard.

Once the critical pathways have been determined, a tailored monitoring strategy can be devised to evaluate exposures. A high vapor pressure solvent may be primarily evaluated for inhalation exposure unless there is also significant skin contact (either liquid or vapor form); then, biological or dermal monitoring may be needed. On the other hand, if an agent has very low volatility, the critical pathway may be skin absorption and/or ingestion. A swipe testing program may be used to evaluate contamination, and a biological monitoring program may be used to monitor dose.

Monitoring Objectives

Monitoring objectives can be broadly grouped into three categories: baseline, diagnostic, and compliance.

Baseline monitoring is performed to evaluate the range or distribution of exposures among specified exposure groups. It is the primary data used for determining the acceptability of exposures, the need for diagnostic sampling, and the need for additional controls.

Diagnostic monitoring is performed for specific, special case exposure evaluation. Its main goal is to identify the predominant sources and tasks causing exposures. The results serve as a basis for devising appropriate and efficient control strategies.

Compliance monitoring is performed to make formal comparisons with OELs for acceptable exposure determinations. The sampling strategy for evaluating compliance is usually a worst-case or "highest exposed worker" approach.

Monitoring Methods

The three broad groupings of monitoring methods that differ in their objectives and techniques are personal, area, and dermal monitoring.

The goal of personal monitoring is to characterize the dose of an environmental stressor that a worker receives during the time period of interest. The dose is seldom measurable, so surrogates for the dose must be measured (e.g., effective exposure). The most common surrogate is worker breathing zone concentration (i.e., the average concentration of an agent near the worker's nose during the time interval of interest). The measured concentration represents potential exposure. The dose is often lowered when personal protective equipment is worn.

Area air monitoring is usually performed to evaluate background concentration levels being experienced by most workers in an area or to provide real-time evaluation of acutely hazardous substances. Area monitoring results can be used in time trend analysis to detect seasonal variation, operation changes, or changes in the efficiency of engineering controls. Area monitoring is not a substitute for personal monitoring since worker tasks and mobility often significantly influence breathing zone concentrations.

Although the dermal route or skin absorption has been recognized as an important pathway of exposure, monitoring methods are not well defined. For materials such as glycol ethers, methylene dianiline (MDA), benzene, pesticides and polycyclic aromatic hydrocarbons skin exposure is often the major contributor to dose. Skin patches, bioassay and other techniques may be used to estimate exposure.

5.4 Data Interpretation and Reassessment

The exposure data must be interpreted to determine whether the exposures indicate an acceptable work environment. Three decisions are possible when analyzing the acceptability of occupational exposure data:

(1) exposures are acceptably low or non-existent;

(2) exposures are too high and corrective action is necessary; or

(3) there are insufficient data to make a decision and reassessment is necessary.

These decisions can be based upon statistical test, professional judgment, or a combination of the two. Professional judgment refers to the integration of all that is known about the operation including monitoring results, culminating in an evaluation of the acceptability of exposures. Decisions must also be made regarding the appropriateness and utility of medical surveillance for a given exposure situation. Once these determinations have been made, then recommendation for material substitution and engineering, administrative, and personal protection controls can be made for unacceptable exposures and a reassessment frequency can be established for the operation. The results of medical surveillance studies and health hazards evaluations will be used in the reassessment process.

5.5 Recommendations and Reporting

Each exposure assessment must be documented to include all relevant information and any written recommendations. This report is the primary vehicle for communicating survey results to employees, supervisors and management. These exposure records serve as a starting point for new assessments and serve as a baseline for trending. The Hazard Assessment and Control database, in coordination with the Sample Tracking and Reporting (STAR) system will be used to maintain this information (see Appendix A for the Hazard Assessment and Control form and instructions for completing it). Health Services will access this information to determine the breadth and level of stressors in the workplace and understand their potential effect on employee health and safety. Health Services will share with Hazards Control its recommendations resulting from individual medical screening examinations and medical surveillance studies.

Appendix 1. Hazard Assessment and Control Form

HAC # _____

Hazard Assessment and Control

Operation Description

Building _____ Room/Area _____ Safety Procedure or Work Permit No. _____ Is One Required? _____

ES&H Team _____ Program_____ Preparation Date _____ Operation Start Date _____

Supervisor or Responsible Person _____ Employee No. _____ Phone/Page No. _____

Operation Code(s)* _____ Hours/Day _____ Days/Year _____

Operation Description:

Personnel Involved: Name(s)	LLNL Employee No.	Highest Exposed Individual(s)	Job Category Code*

Comments:_____

Hazard Evaluation

Hazard(s)*:

Potential for: IDLH _____ Oxygen Deficiency _____ Peroxide Formation _____

No.	Agent	Exposure Level*	Exposure Type*	Pathway(s)*	Evaluation Type*	Current Standard	Reference Source*
1							
2							
3							
4							

Is Additional Monitoring Necessary? Yes _____ No _____ Under Review _____

Rationale:

If the Answer is Yes, also complete the following:

	Agent No.	Method*	Medical Surveillance	Dates for Initial Monitoring	Periodic Monitoring Frequency*

* Refers to Items With Lookup Tables

Completed by: _____

Approved by:_____

General Comments

Control Methods

Engineering Controls:

Eyewash/Shower	
Glovebox*	
Hood/fan number	
Interlocks	
Portable Ventilation	
Other Engin. Controls	

Comments:_____

Administrative Controls:

Training Requirements:	
Posting/labeling	
HHC Poster	
Other	
Other Admin. Controls	

Comments:_____

Personal Protective Equipment*:

Eye protection*	
Garments*	
Gloves*	
Head protection	
Hearing protection	
Safety shoes	
Shoe covers	
Other	

Comments:_____

Respiratory Protection Requirements:

Air Purifying Respirators (complete both sections herein):

-Filter/Cartridge Type	
dust/mist (disposable)	
paint/pesticide	
HEPA	
acid gas	
organic vapor	
Comb.(specify type)	
Canister (specify type)	
-Configuration	
half mask APR	
full facepiece APR	
PAPR(specify type)	

Will contamination of HEPA cartridges prevent reuse?____ Note any other decontamination instructions below.

Air supplied:	
SCBA	
Airline	
Airline w/ egress bottle	
Type (if **not** Full Face)	
Air source/location	

Comments:_____
_____

Frequency of Respirator Exchange (if not daily) _____

Issue Point Administrator _____ Badge No. _____

Issue Point Location _____

Expiration/Update Date _____

Additional Control Requirements

Appendix 2. Hazard Assessment and Control Form Instructions

Hazard Assessment and Control Form Instructions

In order for hazard assessment and control information to be most useful, it must be able to be stored and retrieved in an appropriate fashion. As such, it is necessary to standardize the entry of data in each of the fields. The computer database system (HAC) has been designed to only allow entry of data that meets the proper format requirements. Where indicated below, the database maintains "Lookup Tables", which are summarized herein. Note: these tables may be updated periodically, to reflect changing needs. If you identify any additional needs, please contact Robb Hadley at Lab extension 2-2033, or via QuickMail™.

Instructions by Field name

Operation Description

Building: The LLNL Building or Trailer number is to be entered. If the activity is outside of a building, but exposure is related to that building, the building number should be entered. If the project is onsite, but not building related (e.g., weed abatement spraying) then insert the building that the employees work out from (e.g., gardeners doing weed abatement work from Building 514). If the project is offsite, indicate its location here and in the next field, as appropriate.

Room /Area: Enter the room number or designate the area with up to 20 alphanumeric characters.

Safety Procedure or Work Permit No.: Enter the applicable OSP, FSP, or RWP, number (asbestos, carcinogen, radiological work, lead, etc.).

Is One Required?: Mark this box if an OSP, FSP, RWP, or Work Permit is required, but not yet complete.

Confined Space Permit required?: Mark with yes or no if a confined space permit will be completed for this activity.

ES&H Team No.: Enter the LLNL ES&H Team Number (1-4).

Program: Indicate the name of the Program or Department that this activity is under. If individuals are from different host programs (e.g., matrixed, offsite, etc.,), only indicate the LLNL Program or Department responsible for the activity.

Preparation Date: Enter the date that the hazard assessment process was initiated.

Operation Start Date: Enter the date that the operation is scheduled to begin. If it is in process, enter the word "continuing".

Supervisor or Responsible Person: Enter the name of the individual that has primary responsibility for the operation. If an employee number is entered in the adjacent field, this field will automatically be completed from the People database. (see below)

Employee No. : Enter the LLNL employee number of the Supervisor or Responsible Person.

Phone/Pager No. : Enter the Lab extension or pager number of the Supervisor or Responsible Person.

Operation Code(s): The most appropriate code(s) from the following table should be entered for the activity covered by the hazard assessment. A maximum of three entries are allowed. (Note: these codes may not be directly related to a person's LLNL job category.)

Abatement	Loading
Characterization/Assessment	Machining
Cleaning	Mixing
Computer Operations	Moving
Construction	Oversight
Decommissioning	Painting
Decontaminating	Spray Painting
Demolition	Surface Preparation
Equipment/Facility Maintenance	Testing
Excavation	Welding
Handling	Other (specify)_____

Hours/Day: Enter the approximate number of hours per day that the operation covered by the hazard assessment normally occurs, when performed.

Days/Year: Enter the approximate number of days that the operation covered by the hazard assessment occurs annually.

Operation Description: Enter written information about the operation, that is not contained in other fields. Descriptions of work activities from other documents can be imported to this field.

Personnel Involved: Enter the name and **LLNL Employee No.** of the personnel involved (Note: the HAC database is linked with the LLNL "People" database, and will fill in the names.)

Job Category Code: Select and insert an appropriate job category (from the following list) which best describes the activity each worker is performing during the operation (Note: these "Job Categories" may not relate to worker's job titles.)

Abatement Worker	Machinist

BioMed Worker
Chemical Worker
Clerical/Administrative
Computer Programmer
Construction Worker
Custodian
Driver
Electrician
Environmental/Hazardous Waste Worker
Equipment Operator
Field Engineer
Food Service Worker
Gardener
Graphics Worker
Hazards Control Personnel
Health Care Worker
Laborer, NOC
Maintenance Worker, NOC
Mech Tech
Mechanic
Microelectronics worker
Optics Worker
Painter
Physicist
Plumber
Protective Service Officer
Radiation Worker
Salvage Yard Worker
Utility Maintenance Worker
Warehouse worker
Welder
Woodworker
Other Scientists/Engineers, NOC
Other (Specify)_____

Highest Exposed Individual(s): This area should be marked with an "X" for the person(s) most likely to receive the highest exposure while performing the operation. (This information will be used for compliance or worst-case monitoring.)

Hazard Evaluation

Hazard: The database will ultimately list all hazards associated with "Agents" entered in that section (although they may be overwritten). The table below specifies those identified hazards.

Hazard Code

Carcinogen: (Type) _____
(Control Level) _____
Combustible
Corrosive
Ergonomic
Flammable
IDLH
Irritant
Laser
Magnetic Fields
Metal
Noise
O_2 Deficiency
Organic Solvent
OSHA Health Std
(Specify)
Oxidizer
Peroxide Former
Pressure
Pyrophoric
Radiological
Reproductive Hazard
RF / µ-wave
Sensitizer/allergen
Skin Absorber
Thermal Stress
UV
Other (Specify)

Potential for: IDLH ____ Oxygen Deficiency ____ Peroxide Formation ____

Mark the appropriate box(es) if there is a potential for IDLH, oxygen deficiency, or peroxide formation.

The following table (referred to as "agent table") should be completed, using only the terms from the lookup tables and directions that follow:

No.	Agent	Exposure Level *	Exposure Type *	Pathway(s)*	Evaluation Type *	Current Standard	Reference Source *
1							
2							
3							
4							

Exposure Level

(Express numerically)
Units:

ppm
mg/m^3
F/cc
µg/cm^2
dBA
C WBGT
Other (specify)
mrem
mrem/Hr
µCi/cc
mW/cm^2
J/cm^2
mT

Exposure Type

8 hour TWA
STEL
Ceiling
Peak
Impulse
Other (specify)

Pathways

Inhalation
Dermal
Ingestion
Aural
Lens
Extremities
Skin (Whole body)
Specific Organ
Whole Body
Other (specify)

Evaluation Type

Qualitative
Calculated Worst Case Scenario
Semi-quantitative/Direct Reading
Quantitative Estimate

Reference Source

OSHA
Cal/OSHA
ACGIH
AIHA
NIOSH
DOE (Specify)
MSDS
LLNL
NRC (10 CFR 20)
Manufacturer's recommendation
Other (Specify)

No. - This is an arbitrary serial number (from 1 to n) used to identify agents later (see the Monitoring Table below)

Agent - This field requires the identified hazard(s) be entered by proper name (e.g., chemical or physical agent name from the TLV booklet) or IUPAC nomenclature. If the CAS number is entered here, other fields will be populated with information from the database. In situations that involve multiple hazards, only the "primary" hazards should be listed. Primary hazards should include all carcinogens as well as any other exposures that may routinely exceed ten (10) per cent of an established occupational exposure limit.

Exposure level - This column should receive a numerical value as to the exposure intensity or concentration that the worker(s) may be exposed to. If no quantitative data is available, an estimate should be inserted, and follow up information will later be added from the STAR system.

Exposure type - This field represents the type of exposure(s) represented in the ***Exposure Level*** column.

Pathway - Enter the predominant route of exposure (from the Lookup Table) anticipated. If more than one exists, that requires a separate monitoring protocol, enter separate rows.

Evaluation Type - Enter the basis for the exposure determination, from the Lookup Table. If this entry is based on professional judgment, enter "estimate".

Current Standard - Enter the applicable DOE established exposure standard in effect at the time of entry. Ultimately, these can be selected from the Database.

Reference Source - Enter the source (e.g., ACGIH, OSHA, DOE Order and no., etc.). Again, these will ultimately be in the database.

Is Additional Monitoring Necessary: - Mark **yes**, **no**, or **under review**, as appropriate.

Rationale: Enter the reason(s) for conducting or not conducting monitoring. Reasons for not monitoring might include:

Agent is completely enclosed within a glovebox;
Quantity of agent too small to present hazard (see calculation below);
Vapor pressure of material is too low to pose an inhalation hazard (v.p. = 0.003) and dermal and ingestion pathways are not probable.

The "monitoring table" should be completed in accordance with the data provided in the following lookup tables.

Agent No. - Coincides with the serially listed numbers from the “agent table” above.

Monitoring Types(s): from the list of: **Breathing Zone, Area Sample, Ceiling, TWA, STEL, Swipe, Bioassay**, or specify an **Other** type.

Method : - Indicate the specific analytical or sampling method for each agent. If an agent requires more than one monitoring method (e.g., ceiling and swipe), then enter an additional line entry with the same agent number.

Medical Surveillance - Mark this column if medical surveillance appears to be required. This will automatically "flag" Health Services to evaluate the need.

Date(s) for Initial Monitoring - Enter the date(s) that initial monitoring should be completed by.

Periodic Monitoring Frequency - Enter the frequency that monitoring should be repeated.

Method

Laboratory analyses
- LLNL Analytical Lab Standard Procedure
- Radiological Analysis
- Other Lab method (specify)_____

Direct Reading Methods
- PID (e.g., HNu)
- MIRAN
- Colorimetric Tube (specify type)____
- Type 2 Sound Level Meter
- Noise Dosimeter
- Octave Band Analyzer
- Radiation Meter
- Other (Specify type)_____

Periodic Monitoring Frequency

Semi-annual (every six months)
Annual
Biannual (every two years)
Triennial (every three years)
To be determined
Other (specify)_____

Medical Surveillance Categories

Lead	BioMed Sciences
Asbestos	High Explosives
Beryllium	Protective Services
Hazardous Waste	Laser Eye Exam
Fire Fighter	Radiological

Completed by - Indicate the discipline member's name that conducted the assessment.

General Comments

In this field, enter any additional information that might be helpful for other personnel that may refer to this Hazard Assessment in the future. For convenience, you may import additional information from other documents, such as OSPs or other descriptive documents.

Control Methods

In the Control Methods section, specify all methods specified for worker protection. In the case of multiple areas, phases, or tasks, covered under one Hazard Assessment, ample space is available to address these items on each line. Similarly, the database is designed to capture differing control requirements in parallel fields.

Engineering Controls:

Eyewash/Shower - Mark whether an eyewash or shower are required.

Glovebox No. - Enter the LLNL number assigned to the area glovebox, if it is required for the job.

Hood/Fan No. - Enter the LLNL number of any required ventilation system.

Interlocks - Mark if interlocks are in place or will be required for the job.

Portable Ventilation - Indicate what type, if any, portable ventilation system is required for the job.

Other Engin. Controls - Specify what type of other engineering controls are required.

Comments - Enter any comments related to engineering controls.

Administrative Controls

Training requirements: - Specify the training requirements, per the lookup table of HS Course numbers, or if no HS number is assigned, enter a course title.

Posting/labeling -

> **HHC Poster** - Mark this section if an LLNL Health Hazard Communication or Hazards Notice Poster is required.
>
> **Other** - Enter any other requirements here, for example OSHA or DOE Order specific signs or notices (e.g., Confined Space, Asbestos, Inorganic Lead, Noise, RMMA, etc.) are necessary.

Other Admin. Controls - Specify all other administrative controls that are required.

Comments - Enter any comments related to administrative controls.

Personal Protective Equipment

Complete each section pursuant to the Lookup tables below.

Gloves - Enter the applicable glove(s) required for a project, from the lookup table. This table will ultimately list LLNL stores items with descriptions and catalog numbers, and allows for multiple layers and has the option of specifying other gloves available through vendors.

Eye protection - Indicate the minimum required protection from the Lookup table. If multiple eye protection is required (e.g., goggles and faceshields) enter all types.

Head protection - Indicate what head protection is required from the Lookup table.

Hearing protection - Mark which type of protection would be necessary to meet protection requirements.

Garments - Mark which type of garment or garments are required.

Comments - Enter any other comments related to personal protective equipment.

Respiratory Protection Requirements

Air purifying respirators: Complete both sections, including mask type/configuration and required cartridge, filter, or canister. If a higher level of protection is optional, this need not be included, as workers can always upgrade upon request (ensuring that alternate equipment is available).

Will contamination of HEPA cartridges prevent reuse? - Unmark this space if external cartridge contamination will not prevent reuse.

Air supplied respirators: Indicate what type (i.e., pressure demand with egress, continuous flow, SCBA, etc.) and indicate if something other than a full face piece is required.

Air source/location: Enter the type and location of the air source (e.g., if breathing air is currently available or if a compressor or tube bank may be required).

Comments - Enter any additional comments or requirements pertaining to either air purifying or air supplied respiratory protection for this project.

Note specific decontamination instructions below - If any specific decontamination of respiratory protective equipment is necessary to prevent removing contaminants from the work area.

Frequency of Respirator Exchange (if not daily) - Indicate if more or less frequent exchange is specified for this area.

Issue Point Administrator - Enter the name of the primary Issue Point Administrator (IPA) and their respective **Employee No.**

Issue Point Location - Enter the primary location that respirators will be issued from.

Expiration/Update Date - Enter the date that you would like the Control Methods section approval to expire. Note: this may not exceed one year.

Additional Control Requirements/Procedures: - Enter any other job specific Control Requirements, not yet addressed.

Interdepartmental letterhead

Mail Station L- 383

Ext: 4-5162

Hazards Control Department
Technical Support and Policy Division

March 17, 1998

TO: Distribution

SUBJECT: Correction to IHPIM - 50: Exposure Assessment and Monitoring Plan

The review of the LLNL Beryllium Control Program (Implementation of DOE N440.1) by DOE/HQ-DP noted an inconsistency in Appendix E (IHPIM - 50: Exposure Assessment and Monitoring Plan) with OSHA methodology for breathing zone sampling. This definition differs from the more usual definition used by OSHA compliance officers in the OSHA Technical Manual, Chapter 1, "Personal Sampling for Air Contaminants".

In practice, industrial hygiene personal sampling at LLNL has been conducted in accordance with the OSHA Technical Manual.

Therefore, the definition for Breathing Zone in Section 3.0 of IHPIM - 50 is revised to read:

Breathing Zone	a hemisphere forward of the shoulders with a radius of approximately 6 to 9 inches

Please attach this memorandum to Appendix E of the LLNL Beryllium Control Program and/or IHPIM - 50 of the Industrial Hygiene Policy and Information Manual.

If there are any questions on this policy, please contact me at (925) 424-5162.

George P. Fulton, CIH
Hazards Control Department

University of California
Lawrence Livermore
National Laboratory

52

PERSONAL MONITORING REPORTS

Purpose

Results of personal monitoring for chemical, biological or physical agents are to be reported in writing to the employee's supervisor, the employee, Health Services and other appropriate individuals.

Requirements

29 CFR 1910.20, Access to Employee Exposure and Medical Records,
29 CFR 1910.95, Occupational Noise Exposure,
29 CFR 1910 Subpart Z, Toxic and Hazardous Substances,
8 CCR 340.2, Notification to Employee of Exposure Required.
DOE Order 5480.10, (9)(b), Contractor Industrial Hygiene Program,
DOE Order 5480.8A, (11)(a), Contractor Occupational Medical Program,
DOE Order 232.1, Occurrence Reporting

Policy

Industrial Hygienists, IH Sampling Techs and ES&H Techs conduct personal monitoring of various types to evaluate employee or contractor exposure to potentially harmful chemical, biological or physical agents. The results of this monitoring are to be reported in a timely fashion by the responsible Industrial Hygienist to the employee's supervisor, the employee and other appropriate individuals. Health Services must be provided with copies of all reports indicating that a person was exposed above a regulatory limit.

Responsibilities and Technical Requirements

1- In all cases, the results of monitoring shall be provided to the supervisor of 1) the

employee(s) monitored, and; 2) employee(s) not monitored but assumed to be represented by this monitoring (if any).

2- The notification shall include at least the following elements:

- Actual measured exposure.
- Calculated 8-hour time weighted average, excursion, short-term or ceiling exposure level, with a brief discussion of the relevance of this figure.
- Relevant exposure limits.
- Types of personal protective equipment used (respirator, gloves, etc - specify type of each).
- Where overexposures are determined, regardless of the use of a respirator, state recommendations for improving engineering, administrative or personal protective control measures to reduce exposure.
- Additional training requirements based on results.
- Additional medical surveillance requirements based on results.
- Need for additional monitoring (if any).
- Reference to appropriate sections of Health and Safety Manual or Supplements or OSHA standards (Federal and California, as appropriate).
- Statement of supervisors responsibility for employee notification.

3- Written notification to the supervisor of the affected employee(s) and the individual employee(s) shall be provided promptly after the receipt of monitoring results. Results that indicate actual overexposure (no respirator used or protection factor inadequate) shall be provided in writing to the supervisor and employee within 5 days of receipt of the written laboratory analytical report. The Industrial Hygienist must verbal notify the Supervisor, ES&H Team Leader, Industrial Hygiene Technical Leader, and the Health Services Department as soon as possible. The Industrial Hygienist and the Industrial Hygiene Technical Leader will consult with the ES&H Team Leader, Program management and the Assurance Officer to determine if an Unusual Occurrence report is required. If an Unusual Occurrence report is required, the area Assurance Office will provide the required information to DOE including a description of the overexposure and what corrective actions are being implemented.

4- More specific notification timelines, as prescribed by OSHA, are listed below;

Agent	Time (working days)	When	How
Asbestos (Gen. Ind)	15	All Monitoring	Indiv./Post
Asbestos (Const.)	ASAP	All Monitoring	Indiv./Post
Acrylamide	5	All Monitoring	Each Employee
Arsenic	5	All Monitoring	Each Employee
Benzene	15	All Monitoring	Indiv./Post
Cotton Dust (Primary)	20	All Monitoring	Each Employee

Coke Oven Emissions	5	All Monitoring	Each Employee
1,2-Dibromo,3-Chloropropane	5	All Monitoring	Each Employee
Ethylene Oxide	15	All Monitoring	Indiv./Post
Formaldehyde	15	All Monitoring	Indiv./Post
Noise	NS	>85 dBA TWA	Each Employee
Lab Standard Monitoring	15	All Monitoring	Indiv./Post
Lead	5	All Monitoring	Each Employee

Note: Each employee means "each employee in writing"; ASAP = as soon as possible; NS = not specified.

5- The notification provided by Industrial Hygiene will instruct the supervisor to notify the affected employee(s) of the sampling results and interpretation of the results within the specified timeline. OSHA permits posting as a means of employee notification.

6- The Industrial Hygienist may distribute the results to other directly responsible individuals or organizations, such as Health Services.

7- Where the monitoring represents the exposure of a contract employee, the LLNL contract representative shall also be sent a copy of the report.

8- All monitoring reports shall be copied to the ES&H Team Building File, the IH Building File and the IH.Date File.

9- Examples of report formats are provided as attachments. The most suitable format will be determined by the Industrial Hygienist based on the nature of the monitoring project and the time available to report the results.

References

none

Appendices

Example Memo Formats
Excerpts from DOE Order 232.1, Occurrence Reporting

Interdepartmental letterhead

Mail Station L - CC

Ext: X-XXXX

Hazards Control Department

Month dd, 199x

TO: Supervisor

FROM: Industrial Hygienist

SUBJECT: Report of <Agent> Personal Monitoring Results - BXXX

Personal air samples were collected during <task or operation> on <date>.
<Description of task or operation>.
The samples were collected using <equipment> and <procedure>. <Equipment was pre- and post-calibrated using ...>.
Results were compared with <applicable standard/regulation>.

The results are as follows:

Employee	Operation	Sample Time (minutes)	Result	Calculated TWA or STEL	Regulatory Limit
Employee 1	Operation or Task	xx min	yyy	zzz	xyz
Employee 2	Operation or Task	ff min	ggg	hhh	jkl

Controls used during the operation are <engineering, hoods, glove bag, PPE, respirators>.
<Interpretation of results>.
<Recommendations>.
Supervisors are required to notify his employees of monitoring results; attached are letters to facilitate this notification.

If you have any further questions, please contact me at X-XXXX.

cc: Appropriate Persons
Team X BXXX File
IH BXXX File

Interdepartmental letterhead

Mail Station L- XXX

Ext: X-XXXX

Hazards Control Department

Month dd, 199x

TO: Employee 1, Employee 2

FROM: Industrial Hygienist

SUBJECT: Report of <Agent> Personal Monitoring Results - BXXX

Personal air samples were collected during <task or operation> on <date>.
<Description of task or operation>.
The samples were collected using <equipment> and <procedure>. <Equipment was pre- and post-calibrated using ...>.
Results were compared with <applicable standard/regulation>.

The results are as follows:

Employee	Operation	Sample Time (minutes)	Result	Calculated TWA or STEL	Regulatory Limit
Employee 1	Operation or Task	xx min	yyy	zzz	xyz
Employee 2	Operation or Task	ff min	ggg	hhh	jkl

Controls used during the operation are <engineering, hoods, glove bag, PPE, respirators>.
<Interpretation of results>.
<Recommendations>.

If you have any further questions, please contact me at X-XXXX.

Interdepartmental letterhead

Mail Station L-

Ext:

HAZARDS CONTROL DEPARTMENT
ES&H Team (*no*.)

(*Date*)

TO:

FROM:

SUBJECT:

On (*monitoring date*) air sampling was conducted in your work area to evaluate your exposure to (*agent*). The results of this monitoring shows that your exposure was within acceptable limits. Your exposure was found to be (*concentration*), whereas Department of Energy and OSHA allows (*standard*). This standard is designed to provide conditions that nearly all healthy workers may be routinely exposed without harm.

A full report is being written on this monitoring and will be forwarded to your supervisor. It will also be available for your review. If you would like additional information about this or any other Industrial Hygiene issue please feel free to contact me.

AUTHOR:Typist:Doc Name or #

Dist./cc:

University of California
Lawrence Livermore National Laboratory

Suggested IH Evaluation Results Format

Below is an outline of a suggested IH report outline. This could be presented in standard LLNL memo format, or as an enclosure to a cover memo that can be used to provide an executive summary. The report should be descriptive enough so that our successors and clients would be able to understand the operation, its hazards and the recommended controls.

I. Purpose of memorandum/letter

Should start with a statement that indicates the objective of the report such as - "To present IH evaluation results for XXX operation conducted in Building YYY Room ZZZ and to present recommendations to minimize exposures".

State why the evaluation was done - i.e., employee reports of potential unhealthy working conditions, regulatory requirements, supervisor concerns, Hazard Assessment or walk through which indicated need for further evaluation, etc.

State the date(s) evaluation was conducted.

II. Operation description

Describe operation and its purpose. Identify who performs the work (names and job classifications). List the supervisor, experimenter and lead tech as appropriate.

List chemical, biological and physical agents used/present in the operation. For chemical products, list their (relevant) components. Identify equipment that produces physical agents. Note how equipment and materials are being used and what factors (including work practices) may contribute to or help control exposures.

Describe health hazards associated with chemical, biological and physical agents as well as their exposure criteria. Note: in some cases a federal OSHA or Cal/OSHA expanded standard may exist. If so, the salient features of the standard should be presented.

List control methods in place.

III. Evaluation Methods

List the sampling and analytical methods as well as the equipment used to evaluate the operation. Be sure to mention that equipment used was calibrated (since calibration information should be on IH Data Forms I don't think it is necessary to duplicate it in the report). Indicate who or what job

classification(s) was sampled, which hoods (including ID No.s) were measured, etc. Should also provide rationale used for selection of agents and people sampled.

IV. Evaluation Results

List the results of the evaluation in the same order presented under evaluation methods (above). A results table (similar to those outlined in the more abbreviated report examples) should be included. A table summarizing the results of the control devices evaluated (e.g., vent systems) may be appropriate. In the example given, vent requirements and other relevant criteria should be included. Tables should be stand alone and presented on a separate page. In some cases where a couple of PID, indicator tube measurements, vent measurements, etc. were made, a table may not be necessary.

Note any deficiencies found.

Provide an interpretation of the results, including the effectiveness of control methods. Based on measurements & observations, provide a conclusion(s) indicating if a health hazard(s) exists.

V. Recommendations

Based on study results, observations and conclusions, provide recommendations to control exposures and to correct any deficiencies found. Be sure to note if additional monitoring is required (and when).

Indicate if a DEFTRACK was written or if an OSP/FSP is needed.

Provide your phone number and pager so the client (or other parties) can contact you if they have questions/comments.

VI. Distribution

Below is a recommended distribution.

Team Files
IH Bldg.Files
Team IH Discipline Members
Team Leader/Deputy Leader (as instructed by Team Admin.)
TSPD Technical Leader
Area Technician
Other Program Personnel (as appropriate)

LLNL Beryllium Surveillance Program

I. PURPOSE OF SURVEILLANCE PROGRAM

The purpose of this surveillance program is to identify individuals who are at risk for beryllium related diseases as a result of their employment at LLNL. The program is composed of six interrelated tasks and includes on-site exposure assessments as well as the identification, notification, scheduling, testing, and retesting of current LLNL employees who are or may have been exposed to beryllium during their employment at the lab. All current employees will be notified regarding the program and offered the opportunity to participate. After review of a screening questionnaire, individuals are offered a test for sensitivity to beryllium (BeS) (as well as a chest radiograph in selected cases). Further medical evaluation to determine the presence of chronic beryllium disease (CBD) is offered to those eventually identified as beryllium sensitized or who have suspicious lung pathology on chest x-ray (CXR) B-reader examination. Based on the results of the initial evaluation and the employee's beryllium exposure priority group, retesting is offered on a periodic basis.

This program is designed to: 1) provide ongoing medical surveillance of current employees who may have been exposed to beryllium during their employment at LLNL, 2) identify current LLNL employees that have developed sensitization to beryllium as a result of exposure to beryllium while employed at LLNL, 3) offer a detailed medical evaluation to determine the prevalence of CBD in those individuals identified as beryllium sensitized (or who have findings on their CXR suggestive of CBD), and 4) provide information regarding patterns of Be sensitization in Be exposed workers at LLNL for the purpose of future prevention efforts.

II. STANDARDS/REFERENCES

OSHA Permissible Exposure Limit (PEL): 2 $\mu g/m^3$, 8-hour time weighted average; acceptable ceiling concentration 5 $\mu g/m^3$; acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift 25 $\mu g/m^3$ for 30 minutes. [Ref: 29 CFR 1910.1000, Table Z-2.]

American Conference of Governmental Industrial Hygienists Threshold Limit Value (TLV®): 2 $\mu g/m^3$, 8-hour time weighted average, A-1 designation; short term exposure limit (STEL) 10 $\mu g/m^3$, A-1 designation.

LLNL Administrative Action Level: 0.2 µg/m^3, 8-hour time weighted average. [Ref: Health & Safety Manual, Supplement 21.10.]

International Labor Organization (ILO). Guidelines for the use of ILO international classification of radiographs of pneumoconioses. Geneva, Switzerland: International Labor Office, 1980. Occupational Safety and Health Series No 22 (Rev).

Harris J, Bartelson BB, Barker E, Balkissoon R, Kreiss K, Newman LS. Serum neopterin in chronic beryllium disease. *Am J Indus Dis* 1997; 32:21-26.

Kreiss K, Newman LS, Mroz MM, Campbell PA. Screening blood test identifies subclinical beryllium disease. *J Occup Med* 1989; 31:603-608.

Parkes WR. *Occupational Lung Disorders*, Second Edition. Butterworth and Co., Ltd., London (1985)

Stange AW. EG&G Rocky Flats. Rocky Flats Environmental Technology Site, Golden Colorado. Publication pending.

III. REVIEW OF BACKGROUND INFORMATION / DEFINITIONS

Chronic Beryllium Disease – Respiratory exposure to aerosolized beryllium, in susceptible individuals, causes an immunological reaction that can result in granulomatous scarring of the lung parenchyma, and progressive respiratory disease. Chronic beryllium disease (CBD) is now recognized to be the result of a beryllium specific T cell-mediated immune response. In CBD the symptoms develop insidiously, commonly within a month to 5 years, and rarely as much as 40 years or more, after last exposure. The most common symptom is dyspnea (breathlessness) on exertion, which is, in some cases, the only symptom. The next most common symptom is an irritating, usually unproductive, cough which is worse in the morning and after exertion and may be paroxysmal (convulsive). Occasionally there is mucoid or purulent sputum, and, though hemoptysis (spitting of blood from the lung or bronchial tubes) has been recorded, it is rare. Breathlessness when exercising may gradually increase and, in cases of advanced disease, become severe when it may be accompanied by anorexia, malaise, lassitude, and loss of weight. Progression of the symptoms of early disease is prevented and those of advanced disease can be alleviated by steroid treatment. Chronic disease, however, may be symptomless or associated with only slight cough and mild breathlessness on effort,

although sudden exacerbations can occur in relation to respiratory infection, surgery, pregnancy, or re-exposure to beryllium compounds.

As CBD has a delayed onset of from less than a year to more than forty years, the following of workers is required if all disease is to be identified and early treatment initiated. As CBD is an immunological disease with evidence of a genetic predisposition, exposure standards developed for the majority of the workers may not be protective for highly susceptible individuals. While a higher prevalence of disease is to be expected among the more highly exposed workers, those with low level exposures must be considered in a comprehensive surveillance program. Medical surveillance of a work force that is possibly exposed to aerosolized beryllium to determine the prevalence of beryllium sensitization or CBD has been shown to be a prudent and practical means of identifying work conditions that can cause disease. The medical monitoring that is performed as a part of the surveillance can identify persons with early disease or sensitivity to beryllium, allowing options including removal from further exposure, medical follow-up, and if needed, treatment.

According to the classic criteria established by the Beryllium Case Registry a diagnosis of CBD included at least four of the following six conditions with one of the first two conditions required: 1) significant beryllium exposure; 2) the presence of beryllium in lung tissue, lymph nodes or urine; 3) radiological evidence of interstitial lung disease; 4) lower respiratory tract disease with a clinical course consistent with CBD; 5) obstructive or restrictive ventilatory defects or decreased carbon monoxide diffusing capacity; and 6) non-caseating granulomas on lung biopsy.

The case definition for CBD (as used by Harris, *et al,* 1997) LLNL will use is: 1) history of beryllium exposure; 2) abnormal blood or bronchoalveolar (BAL) beryllium lymphocyte proliferation test (BeLPT); 3) histological evidence of disease (non-caseating granulomas or mononuclear cell infiltrates on lung biopsy). Diagnosis of all BeLPT positives will be handled on a case by case basis. All BeLPT positives will be referred to Dr. Lee Newman at National Jewish Hospital for diagnostic review, consultation, and confirmation. It is anticipated that the number of BeLPT positives and/or subsequent CBD cases will be extremely low (<2-3 persons).

Beryllium Lymphocyte Proliferation Test (BeLPT) - Chronic beryllium disease occurs when the body becomes sensitized to beryllium. Specifically, T-Lymphocytes become sensitized to beryllium-containing antigens. Lymphocytes in individuals which have become sensitized will

undergo cell division (proliferation) in the presence of beryllium. Conversely lymphocytes of nonsensitized individuals so treated will not undergo cell division. This observation has become the basis for a medical test to determine individuals sensitive to beryllium. Persons who test positive may develop chronic beryllium disease; definitive correlation has not yet been proven although early follow-up results show an approximate 10% per year conversion from Be-sensitized to CBD (this is based on 2 to 3 years of follow-up on most subjects). The test, called the beryllium lymphocyte proliferation test (BeLPT or LPT), uses the technique of exposing cultured blood drawn from the test subject to beryllium compounds. If the lymphocytes are observed to undergo cell division (proliferation), the test is positive and the individual is assumed to be sensitive to beryllium. The accuracy of the test is still under study but thought to be about 94% to 95% accurate.

Beryllium Sensitization – An individual is considered beryllium sensitized when two consecutive peripheral blood LPTs are found to be positive from one LPT laboratory or any two LPT laboratories in combination. Two consecutive positive LPTs are required to identify beryllium sensitization to reduce the potential for "false positive" LPT results.

Serum Neopterin – The pteridine neopterin is produced and released by macrophages under the influence of IL-2 and IFN-γ. Serum neopterin has recently been evaluated as a biomarker of CBD, for use in conjunction with the BeLPT in workplace screening (Harris et al, 1997). In those workers with an abnormal BeLPT, serum neopterin has been shown to have a high positive predictive value, and can identify disease, helping to distinguish it from BeS without the risks of biopsy.

Abnormal Chest Radiograph (possibly associated with CBD) – Posterior/anterior chest radiographs are evaluated according to the International Labor Organization (ILO) classification system for radiographs of pneumoconioses by certified B-readers. The profusion of small opacities is used to determine individuals which might have noncaseation granulomas (the presence of noncaseation granulomas and/or mononuclear infiltrates is consistent with CBD). The abnormal profusion of small opacities is defined as profusion greater than or equal to 1/0. Note that chest radiographs may miss a significant number of chronic beryllium disease cases.

Pre-Placement Examination - A preplacement medical examination should be administered prior to the assignment of an employee to a workplace with the potential for beryllium exposure. Such an

examination assesses each employee's state of health prior to the beginning of potential exposure to beryllium. The preplacement examination is essential to obtain a baseline that can be used to determine whether an employee's health has changed over the period of employment and to identify any pre-existing conditions such as pulmonary obstructive disease, emphysema, or asthma that could influence initial job placement. The preplacement examination emphasizes the respiratory system which is consistent with beryllium's primary health effects which are almost exclusively pulmonary.

Termination Examination - The examination for retiring or terminated employees consists of all of the elements specified under pre-placement examination. In addition, the termination examination should include provisions which take cognizance of the long latency period often associated with the onset of clinical symptoms of chronic beryllium disease. Termination exam provisions should include:

- a thorough review for the employee for the signs and symptoms of CBD
- a discussion with the employee of the long latency period which often intervenes between exposure and symptoms of the disease
- advice concerning the importance of continued periodic medical exams by a physician who has been informed of the employee's former occupational exposure to beryllium

IV. RISK-BASED ASSESSMENT

Medical surveillance can be separated into categories based on known or possible exposures.

Priority Group 1; presumed higher relative risk, would be those individuals who work directly with beryllium or who are known to have been or who may be exposed to levels at or near the current LLNL administrative action level of 0.2 $\mu g/m^3$, time-weighted average for an eight-hour day. This group will have the highest priority for BeLPT testing. Examples: machinist, mechanical technician, janitor, or hazardous waste handler directly involved in handling Be.

Priority Group 2; moderate relative risk, would be beryllium exposure less than the administrative action level, but greater than the exposure one would receive from the environment; these workers are required to be in beryllium work areas, but do not work directly with it. Examples: Shop supervisor, project engineer, Health & Safety Technician.

Priority Group 3; lower relative risk, includes all employees who were in beryllium work areas for brief periods of time, but who did not work

with beryllium nor were they part of a beryllium operation. An attempt should be made to include in this category people who only tour beryllium facilities. If these individuals cannot be prevented from entering the facility, they should be monitored to provide evidence that they were not exposed to beryllium in order to minimize concern regarding their contracting CBD in the future. Examples: Visitor, delivery person, ES&H Team Safety Discipline.

Note: Priority for Be-LPT testing will be as follows: Priority Group 1 > Priority Group 2 > Priority Group 3. Symptomatic individuals will be evaluated on a case-by-case basis and will receive top medical priority.

V. MEDICAL SURVEILLANCE REQUIREMENTS

Pre-Placement
Evaluation to include:
- Medical and Occupational History
- ATS Respiratory History
- Physical Examination, with Pulmonary and Skin Emphasis
- Chest Radiograph
- Spirometry, with FVC and FEV
- CBC, Biochemical Profile, Urinalysis
- Be-LPT if previously exposed to beryllium (recognize that some workers may not be aware that they had previous exposure to beryllium)

Currently Exposed (Priority Group 1)
Every three years:
- Be-LPT
- Focused history and physical
- Clinical Evaluation at any time based on symptoms

Formerly Exposed (Priority Group 1)
Every three years:
- Be-LPT
- If symptomatic (at any time):
  ATS Respiratory History
  Chest Radiograph
  Be-LPT

Formerly Exposed (Priority Groups 2 &3)
Decision regarding medical testing and intervals for Medical Surveillance for Priority groups 2 and 3 will be made after analysis of BeLPT prevalence rates in Priority group 1 (Fall '98).

Termination

If no examination within last twelve months:

- Same as "Priority Group 1"
- Retiring beryllium workers will be given copies of their occupational exposure history and medical records. These records provide the retiree's personal physician with valuable information about the retiree's past exposures and health.

Positive Be-LPT

If Be-LPT is positive:

- Repeat Be-LPT with split specimen at two laboratories. If repeat test is positive (even borderline) at either lab, then treat as confirmed Be-LPT.

Borderline Positive Be-LPT

If Be-LPT is borderline positive:

- Repeat Be-LPT with split specimen at two laboratories. If repeat test is positive (even borderline) at either lab, then treat as confirmed Be-LPT.
- If repeat Be-LPT with split specimen is negative at both laboratories, then continue with follow-up Be-LPT at 1 to 3 year intervals.

Confirmed Positive Be-LPT or Other Significant Indicators of CBD

An employee with a confirmed positive Be-LPT will be offered:

- Clinical evaluation by a pulmonologist experienced in diagnosing CBD. If this clinical evaluation is positive for CBD then treat as needed. If this evaluation is negative for CBD then repeat work-up every 2 years or sooner.
- The clinical evaluation for the diagnosis of CBD would likely include a bronchoalveolar lavage for alveolar lymphocytes and a transbronchial biopsy for histological evidence of pulmonary granulomas. The latter two tests will usually be obtained together because alveolar lymphocytes and lung microbiopsy specimens are both available via a common bronchoscopic procedure. The two tests are complementary in that the histology provides evidence of granulomatous disease and the Be-LPT indicates that beryllium-sensitized lymphocytes are the likely cause for the granulomas.
- Send sample of patient blood for serum neopterin.

Additional Medical Evaluations

- Additional medical attention may be authorized for any employee who has overt signs or symptoms of chronic pulmonary disease or has been involved in a beryllium accident or emergency. Any breathing

difficulties exhibited during respirator fit testing may indicate respiratory problems or disease condition and that employee should receive additional medical examination.

- The attending physician may recommend that an employee be referred for additional diagnostic tests whenever the physician determines that such tests are needed to confirm or refute a diagnosis of chronic beryllium disease.
- Cases of CBD have been identified in persons who have had only brief or occasional exposure to levels that were presumed to be minimal. These cases include neighborhood cases without secondary exposure from others in the household. While there is no way to know for certain that they did not have brief high-level exposure that went undetected, the possibility exists that some individuals are exquisitely sensitive to beryllium. Assuming a low prevalence of disease in this low-level exposed population, screening the entire population does not seem appropriate. A high index of suspicion must remain, however, and individuals having symptoms that may be from CBD should be evaluated. This population must be educated to recognize the symptoms of CBD, and informed about contacting a medical resource that can direct them to a location for further evaluation, if needed.

Medical Surveillance is to continue throughout the employee's tenure of employment, even if the employee is no longer exposed to beryllium, but the employer is not required to provide medical exams for retirees and terminated employees.

VI. POPULATION EFFECTS

Health Services and Hazards Control shall review the results of the medical surveillance program to determine if there are any correlations between incidence of sensitization or disease and Priority Group, exposure potential, or other grouping of workers.

VII. PROCEDURES

A) Identification of Beryllium Exposed Employees

Employees currently on the old LLNL beryllium surveillance program have been automatically enrolled into the revised surveillance program and exposures are being verified. Additions to the surveillance roster will be made on the basis of exposure assessment and survey data. Following a review of their exposures decisions will be made on the appropriateness of a screening evaluation (*i.e.* BeLPT).

B) Medical Removal Plan/Medical Removal Protection Benefits

Employees will be advised on beryllium-associated risks, however the decision to work with beryllium remains with the employee. LLNL is actively developing a policy to offer non-beryllium alternative employment for employees who are beryllium sensitized or have CBD.

VIII. DOCUMENTATION

A) Technical/Administrative Points of Contact:

1) Medical HSD Contact(s)

S. Burastero, M. D.; R. Meister, M. D.

2) Industrial Hygiene Contact(s)

i. G. Fulton, Industrial Hygiene Technical Leader
ii. ES&H Field Team industrial hygienists

B) Authors of Document

R. Meister, M. D.; S. Burastero, M. D.

C) Frequency of Program Review

On an annual, or at other appropriate frequency, Health Services and Hazards Control shall review the results of the medical surveillance program to determine if there are any correlations between incidence of sensitization or disease and Priority Group, exposure potential, or other grouping of workers.